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A STUDY OF COHO SALMON IN SOUTHEAST  
ALASKA<sup>1</sup>

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## ABSTRACT

The 1988 coho salmon *Oncorhynchus kisutch* return to southeast Alaska was the lowest since the 1970's. The poor return seems mostly due to low marine survival in the smolt to adult phase. The 1987-1988 marine survival rate at Neets Bay hatchery near Ketchikan was 0.5%, down from an average 9.4%; the marine survival rate at Salmon Lake was 6.4% down from an average 10.6%; and the marine survival rate at Auke Lake near Juneau, was a near average 18%. Though the smolt to adult survival rates of Yakutat stocks are unknown, the returns approached record high levels. This suggests a north-south gradient of marine survival rates with poor survival in the southern areas and normal to good survival in the northern end of the region.

Harvest rates of indicator stocks varied with their timing and location. At Salmon Lake, 48% of the return was harvested, primarily by the troll fishery. Auke Lake coho salmon had a harvest rate of 38%, suggesting that their migration pattern permitted greater rates of escapement to inside waters. Nahlin River coho salmon, an early-run stock from the headwaters of the Taku River, had a total harvest rate of 54%. Because of its early migratory timing, this stock sustained little harvest by the troll fishery, but 10% were caught by the Juneau marine sport fishery and 19% by the drift gillnet fishery in Taku Inlet. The high contribution to the Juneau sport fishery suggests that early run Taku River stocks contribute heavily to the July - mid August sport catch. In contrast, the "late run" Yehring Creek (Taku River) stocks had a higher overall harvest rate of 76%. Twenty four percent were caught by troll fishery, 47% by the drift gillnet fishery, and 5% by the Juneau marine sport fishery. The harvest of Yehring Creek stock by the sport fishery was greatest during the third week of August, the historical peak of the Juneau sport harvest of coho salmon.

The escapement of adult coho salmon to Salmon Lake was 25% below average. The escapement at Auke Lake was slightly above average and the escapement at Yehring Creek was 33% below the 1986 level. The escapement goal of 1,500 Chilkoot Lake coho salmon was achieved. Escapement indices of spawners from 58 streams suggest a decline in escapement throughout the region, although the magnitude of the decrease is unknown. The weighted mean index of spawners for 1988 was 622 (SE = 259), not significantly different from the 1986 and 1987 levels.

KEY WORDS: coho salmon, *Oncorhynchus kisutch*, escapement, production, return, smolt, harvest rate, contribution, troll fishery, drift gillnet fishery, sport fishery, forecast model, run-strength.

## INTRODUCTION

The purpose of the Division of Sport Fish coho salmon *Oncorhynchus kisutch* research program in southeast Alaska is to improve the management of coho salmon stocks that are important to the region's sport fisheries. Improving management involves optimizing the harvest of returning adults, assuring that the harvest is allocated properly among user groups, and providing for adequate levels of escapement. Data collected on key coho salmon stocks address three goals:

1. Estimate optimum escapement goals for indicator stocks from spawner-return and/or spawner-smolt production models.
2. Estimate time and area of harvest and harvest rate from the recovery of adults coded wire tagged as smolt.
3. Develop models to forecast the run-strength of indicator stocks based on the expected ocean survival rate of smolt and/or the catch of adults from indicator streams in the first few weeks of the fishery.

In 1988, data were collected on coho salmon stocks that either passed through or were located near important fisheries (Figure 1) or were general indicators of stock strength. These stocks were:

1. Chilkoot Lake, Haines - supports an intensive freshwater sport fishery and has the highest known harvest rate (85% +) of any stock in southeast Alaska.
2. Nahlin River, tributary to Taku River, near Juneau - indicator stock for coho salmon that pass through the Juneau sport fishery in July. Ten percent of this stock was harvested by the Juneau marine sport fishery in 1988. July-run Taku River stocks could be adversely affected by developing a terminal fishery created by the introduction of sockeye salmon to Turner Lake. This was the first season of study at this site.
3. Yehring Creek, tributary to Taku River, near Juneau, - indicator stock for coho salmon that pass through the Juneau sport fishery in August. 1988 was the third season of research at this site.
4. Auke Creek, Juneau, (a cooperative research project with the National Marine Fisheries Service, Auke Bay Laboratory, and the University of Alaska-Southeast) - an indicator of stock strength on the Juneau roadside. Research on population dynamics of Auke Creek coho salmon has been continuous since 1979.
5. Salmon Lake, Sitka - indicator for lake stocks in the immediate Sitka area. Research at this site has been ongoing since 1983.
6. Eagle River, Sitka - indicator for stream stocks in the Sitka area. This was the first season at Eagle River; operations were limited to

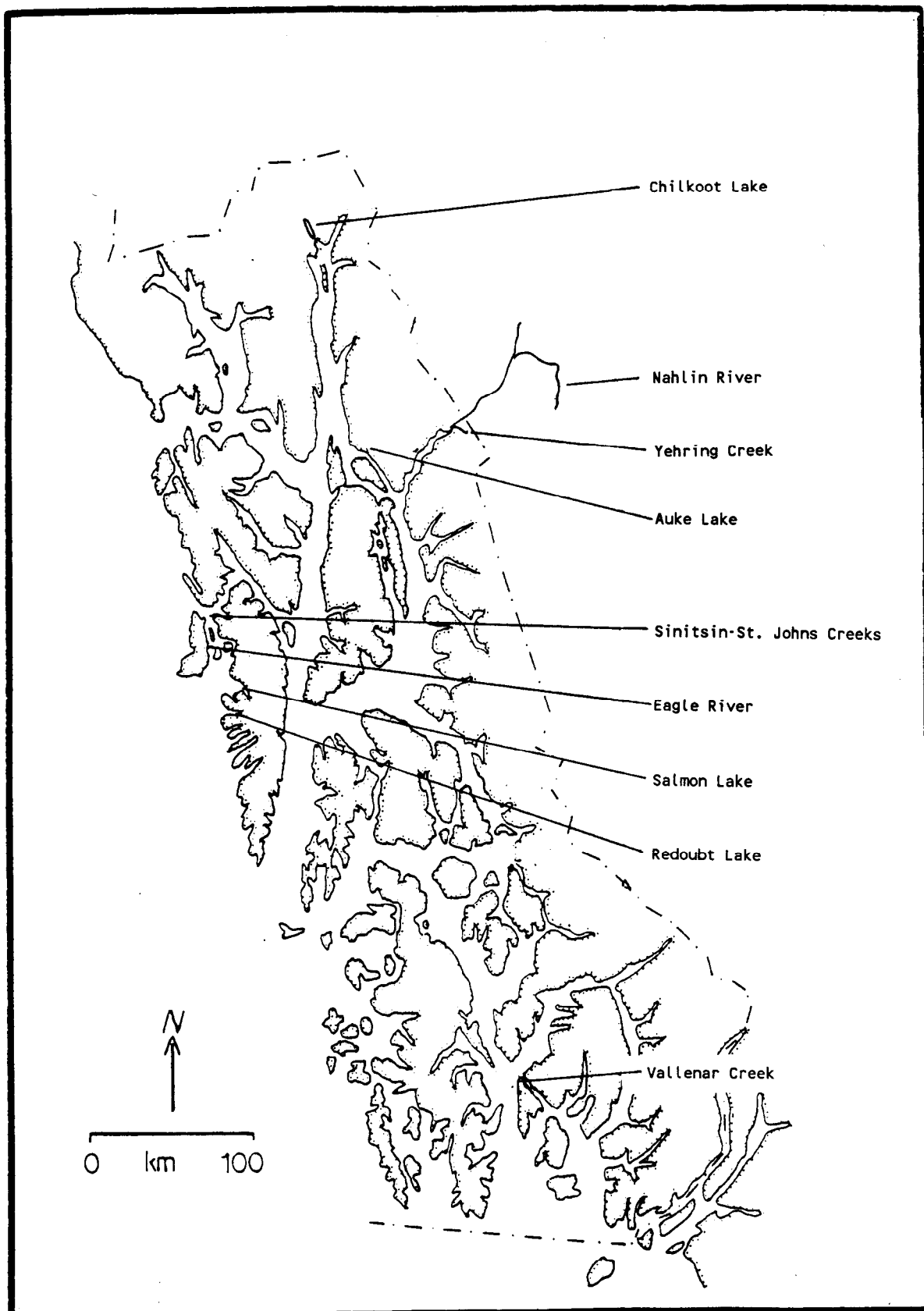


Figure 1. Coho salmon research sites in 1988.

estimation of smolt abundance and coded wire tagging. An adult weir will be added to the program in 1989 to capture the returning adults.

7. Vallenar Creek, Ketchikan - small stream indicator stock. Operations in 1988 were to test the utility of the stream as an indicator site by estimating the abundance of smolt and the 1989 return. It has been dropped from the program because of the small size of the adult population.
8. Redoubt Lake, Sitka - lake stock indicator south of Sitka. Redoubt Lake is a major coho salmon producer with an annual potential production over 65,000 smolt and about 6,000 adults. This site was investigated for one season to corroborate the results from Salmon Lake and better document the 1988 return. The potential of developing a sport fishery on this stock is great; sport fishermen are not currently taking full advantage of this resource.
9. Sinitzin and St. John Creeks - small stream indicator stocks in Nakwasina Sound. The escapement in these streams has varied from 10 to 100 adults over the last five years. Studies since 1987 have monitored the abundance of juveniles in these streams.

Study objectives for the sites were:

1. Count the 1988 escapement of age .1 adult coho salmon at Chilkoot Lake, Nahlin River, Redoubt Lake, Salmon Lake, and Yehring Creek.
2. Estimate the mean length, and the age and sex composition of adult coho salmon at Chilkoot Lake, Nahlin River, Redoubt Lake, Salmon Lake, and Yehring Creek.
3. Estimate the 1988 harvest of age .1 adult coho salmon bound for Nahlin River, Redoubt Lake, Salmon Lake, and Yehring Creek from the recovery of coded wire tagged fish tagged as smolt in 1987 or juveniles in 1986.
4. Estimate the abundance of coho salmon smolt at Eagle River, Salmon Lake, Vallenar Creek, and Yehring Creek in 1988.
5. Estimate (via application of coded wire tags to smolt in 1988) the 1989 harvest of coho salmon returning to Eagle River, Salmon Lake, Vallenar Creek, and Yehring Creek.
6. Estimate the mean length and age composition of coho salmon smolt at Eagle River, Salmon Lake, Vallenar Creek, and Yehring Creek in 1988.
7. Estimate the abundance of juvenile coho salmon > 65 mm in St. John and Sinitzin Creek in July 1988.
8. Estimate the age composition and mean length of juvenile coho salmon > 65 mm in St. John and Sinitzin Creek in July 1988

9. Estimate ordinal indices of coho salmon escapement in a designated set of streams located near Haines, Juneau, Ketchikan, Sitka, Petersburg, and Yakutat in October and November 1988.

## METHODS AND MATERIALS

### Estimates of Smolt and Presmolt Abundance

Coho salmon smolt were captured at Eagle River, Salmon Lake, and Vallenar Creek using stream-type fyke nets with a live box. Fyke nets were fished just above tidewater, and at Salmon Lake, just below the lake outlet. Fyke nets were 1 X 1 meter and about 3 meters long; the cod end was attached to a 10 cm (4 in) plastic flex pipe that led to a floating live box. One to two nets were fished at each site. Leads constructed of 1.27 mm (1/2 in) rebar frames hung with 0.63 mm (1/4 in) vexar were constructed at about a 45 degree angle upstream such that most of the stream was fished. At Salmon Lake several panels were omitted to allow upstream migration of adult steelheads, *Oncorhynchus mykiss*. At Yehring Creek, smolt were captured with trough traps as they exited beaver ponds. The traps were made of 30.5 X 244.0 X 1.25 cm (12 X 96 X 1/2 in) plywood (Figure 2) and installed at spill areas on each beaver dam. Emigrants were directed into the trough by installing a 6.3 mm (1/4 in) mesh hardware cloth or vexar fence along the rim of the dam. Once fish entered the troughs, they were swept through a 10 cm (4 in) rigid plastic pipe to a floating live box.

Smolt were captured from 15 April to 15 June at all sites. They were counted, tranquilized with tricain methane sulfonate (MS 222), marked by complete removal of their adipose fins and tagged with coded wire tags (CWT) following instructions in Koerner (1977). Elliott and Kuntz (1988) and Schmidt (1988) showed that the smallest smolt that could be tagged was 70 mm at Eagle River, Vallenar Creek, and Yehring Creek and 85 mm at Salmon Lake.

A sample of smolt was taken at each site for age-length analysis. Each sampled fish was measured to the nearest 1 mm fork length. Scales were removed from the preferred area of each fish (Anas 1963), applied to a microscope slide, covered with a second slide, and secured at both ends with "scotch tape". Up to four sets of scales could be applied to a slide. The scales were read on a microfiche projector with a 10 mm objective.

In-season estimates of smolt abundance were obtained using mark-recapture experiments. Smolt were captured at Yehring Creek as they emigrated, tagged with a CWT, and released. They were recaptured about 2.5 km downstream with a "lake-type" fyke net just upstream of the confluence of Yehring Creek and Taku River.

At all other sites, pre-smolt were captured upstream of fyke net sites with funnel traps baited with fresh salmon roe prior to any significant emigration. These fish were given temporary fin mark and released. Marked and unmarked fish were subsequently recaptured in fyke nets located downstream. The abundance of coho salmon smolt was estimated with Chapman's modification

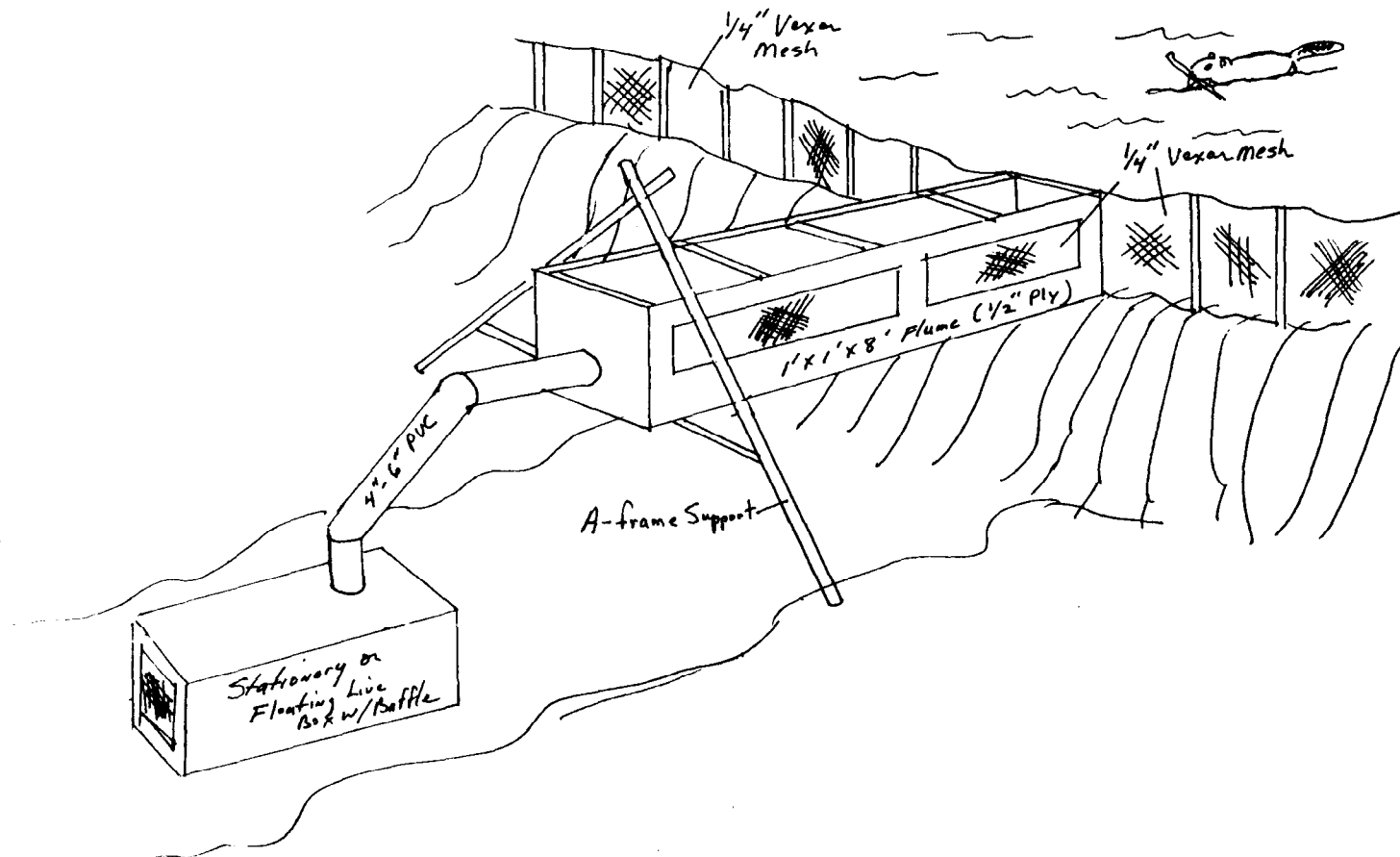


Figure 2. Diagram of a trough trap used to capture coho salmon smolt emigrating from a beaver pond (not to scale).



of Petersen's method (Seber 1982). The calculations for the estimate, variance, and standard error are:

$$1) \quad \hat{N} = \frac{(M + 1)(C + 1)}{(R + 1)} - 1$$

$$2) \quad V[\hat{N}] = \frac{N(M - R)(C - R)}{(R + 1)(R + 2)}$$

$$3) \quad SE = \sqrt{V[\hat{N}]}$$

where:

$\hat{N}$  = estimated abundance;  
 $M$  = number of marked fish released alive into the population during the first sampling event;  
 $C$  = number of fish caught in the second sampling event; and  
 $R$  = number of fish marked in the first event and recaptured during the second event.

Since adults returning to Redoubt Lake with CWTs were tagged either as juveniles in the fall of 1986 or as presmolts in 1987, the abundance during the spring 1987 was estimated by adjusting the fraction of marked adults at the weir by the fraction of the two tag codes in the harvest. Adjustment to the Petersen method in the mark-recapture experiment was as follows:

$$4) \quad \hat{N} = \frac{(M_o + 1)(C + 1)}{(R\theta + 1)} - 1 \approx \frac{(M_o + 1)(C + 1)}{(R + 1)} \frac{1}{\theta} \approx \hat{N}_o / \theta$$

where:

$M_o$  = Number of presmolts released alive with CWTs and clipped adipose fins during the spring 1987;  
 $R$  = Number of adults with missing adipose fins passing through the weir in 1988;  
 $N_o$  = Estimated abundance of presmolts without adjustment;  
 $\theta$  = Fraction of the marked fish inspected in all fisheries combined with the code of the tags used to mark presmolts during spring 1987; and  
 $C$  = Number of adults inspected for missing adipose fins at Redoubt Lake in 1988.

From Goodman (1960), the variance of the estimated abundance is:

$$5) V[\hat{N}] \approx V[\hat{N}_o] \hat{\theta}^{-2} + \hat{N}_o^2 V[1/\hat{\theta}] - V[\hat{N}_o] V[1/\hat{\theta}]$$

where:

$$6) V[1/\hat{\theta}] \approx V[\hat{\theta}]/\hat{\theta}^4 \text{ from the delta method (see Seber 1982, p. 8); and,}$$

$$7) \hat{\theta} = n_t/n$$

$$8) V[\hat{\theta}] = \frac{\hat{\theta}(1-\hat{\theta})}{n-1}$$

where:

$n_t$  = the number in the sample with the tag with the correct code; and  
 $n$  = the number of tags found from all fisheries combined.

Data on age and length of coho salmon smolt was analyzed using SAS (SAS Institute Inc. 1985). For proportions, i.e. estimated age-sex or age length groups, a variance, standard deviation (SD), and standard error (SE) was calculated using:

$$9) \hat{p}_i = \frac{y_i}{n}$$

$$10) V[\hat{p}_i] = [\hat{p}_i(1-\hat{p}_i)/(n-1)] (1-n/N)$$

$$11) SE = \sqrt{V[\hat{p}_i]}$$

where:  $p_i$  = the proportion of fish in the sample  $n$ ;  
 $y_i$  = the number of fish in group  $i$   
 $n$  = the number of fish sampled; and  
 $N$  = the number of fish in the population.

#### Adult Escapement

Weirs were constructed at the outlet of Salmon Lake and Chilkoot Lake, and on the Nahlin River and Yehring Creek in the Taku River. The weirs were standard tripod and picket design with 1.9 cm (0.75") diameter pickets spaced on 5.4

cm (2.125") centers, except for Nahlin River, where the picket spacing was 4.4 cm (1.75") to catch jacks (age .0 adults). The weirs were operated continuously from about 15 August to 15 October 1988. Adult coho salmon were captured in a 2.4 X 2.4 m (8 X 8 ft) upstream migrant trap with a "V" or slot entrance, tranquilized with a 12 volt DC electric shocking basket (Gunstrom and Bethers 1985; Orsi and Short 1987), checked for the absence of an adipose fin (indicating the presence of a CWT), measured to the nearest 1 mm (mid-eye to fork of tail), sexed by examination of external characters, examined for hook wounds, and released alive on the upstream side of the weir.

At each weir, a systematic sample of adults was taken throughout the season to collect data on age, sex, and length. Four scales were removed from the preferred area (Anas 1963), mounted on gum cards, pressed on acetate cards at a later date, and read with a microfiche reader having an objective diameter of 10 mm. Statistics for mean length, and age-sex composition were obtained with procedures listed in the section on smolt.

In past years, a mark recapture experiment was used to estimate the escapement if weirs were overtopped by floods and fish escaped upstream. Fish were given a secondary mark at the weir and recovered upstream with a seine net. This provided a mark-unmark ratio that was used to estimate the number of fish that had escaped upstream during the freshet. However, these estimates were not reliable. Marked adults often left the stream, died, or were killed by predators before stream discharge decreased to workable levels. This caused inflated estimates. Consequently, rather than holding the fish during freshets with the intention of sampling and marking when floods receded, fish were allowed to pass upstream and were counted as they crossed a flashboard. This strategy was successful in achieving a total spawner count at all weirs, though sometimes at the expense of the number of fish sampled.

#### Chilkoot Lake Escapement Estimate:

The Chilkoot weir, located below the outlet of Chilkoot Lake, was removed from 5 October through 8 October 1988 due to high water. An unknown number of adult coho salmon moved upstream during this period. The escapement to the weir was estimated using a bootstrap procedure (Efron 1982) as follows. In the ten years that the weir on Chilkoot River has been operational, there are six years in which the escapement data for coho salmon was complete, i.e. years in which the weir was not overtopped. In 1988, 1,460 fish were counted at the weir; this value is the sum of the "tails of the migration" - fish counted before the weir was overtopped on 5 October and after it was re-installed on 9 October. For each year of continuous escapement data, a "sum of the tails" was calculated by subtracting the number of fish counted from 5 October through 8 October from the total count of that year. The proportion ( $p_i$ ) was obtained by dividing the "sum of the tails" by the total count for year  $i$ . Finally, the 1988 count of 1,460 was divided by  $p_i$  to produce six estimates of escapement for 1988 based on past year's data. A program written in BASIC (Elliott and Kuntz 1988) was used to bootstrap the six possible 1988 estimates to generate a set of 100 values from which a mean and variance was computed. The method makes the assumption that: 1) the rate on migratory timing at the weir is not significantly different among years and 2) that during floods the number of fish that cross the weir is the same as the number

that would be counted if the weir was operational. For example, fish holding below the weir would cross in the first day of a freshet rather than over a week's time had the weir been operational.

#### Estimated Harvest

Coded wire tags were recovered from the troll, purse seine, and gillnet fisheries by a port sampling program (Division of Commercial Fisheries) and from the sport fisheries through creel surveys (Division of Sport Fish). Recovery of tagged adults at the weirs was used to compute the tag-to-untagged ratio of the return.

The procedures listed in Clark and Bernard (1987) were used to estimate harvests in commercial and sport fisheries of stocks tagged with CWTs. The estimates were based on information from the Division of Fisheries Rehabilitation, Enhancement, and Development Division (FRED) on the following:

- 1) number of coho salmon harvested;
- 2) fraction of the harvest inspected for missing adipose fins;
- 3) number of coho salmon in the sample with missing adipose fins;
- 4) number of fish heads that reached FRED Division;
- 5) number of these heads that contained CWTs;
- 6) number of these CWTs that were decodable; and
- 7) number of decodable tags of the appropriate code(s).

Each calculation was stratified by fishing quadrant and by fishing period. Since information from FRED Division by fishing district are tallies from landings of fishermen that fished exclusively in that district, data from fishermen that fished several districts is excluded from the tallies. Since almost no fishermen fish in more than one of the larger quadrants during an opening, data stratified by quadrants is more comprehensive than data from fishing districts. Estimates were stratified by fishing period because of the delay between the inspection and the reporting of the catch. Inspection for missing adipose fins often occurs on tenders that deliver and record their catch 7-10 days later (Ben Van Alan, personal communication). Under these circumstances, stratifications finer than two weeks would often bias the estimates. Since the samples drawn during each stratum will be independent samples, the estimate of total harvest will be the sum of all the stratified estimates. The variance of the total harvest will likewise be the sum of the stratified variances. The harvest rate, i.e. exploitation rate, was calculated as the estimated harvest of a stock divided by the total estimated return of the stock and the variance of the harvest rate was approximated by:

$$12) \quad V[E] \approx V[H]S^2 / R^4$$

$$13) \quad SE = \sqrt{V[E]}$$

where: E = the exploitation rate;  
H = the estimated harvest;  
S = the escapement; and  
R = the return.

The variance and SE of the contribution of CWT'ed stocks to sport fisheries were approximated using the methods cited in Vincent-Lang et al. (1988).

### Escapement Indices

Indices of coho salmon spawner abundance were obtained in a designated set of streams in the region. Specific sections of these streams were surveyed by the same personnel, using the same methods, and on the same dates as in past years (Elliott 1987; Elliott and Kuntz 1988). Streams that were accessible by road were surveyed up to three times; remote streams were surveyed only once. The indices were stratified by stream length and whether it was a lake system as follows:

Strata (miles)	Streams in samp. ( $n_i$ )	Number of Streams in Region ( $N_i$ )
0 - 5	15	1,525
5 - 20	23	701
≥ 20	13	468
Lakes	7	189
Total	58	2,883

The estimated number of streams in the region in each stratum ( $N_i$ ) was obtained from a database of stream attributes assembled for the U.S. Forest Service Tongass Land Management Plan (U.S. Forest Service 1979). The total number of streams is the number of cataloged anadromous streams in the region as of 1987 and the number of lakes is from Reed (1971). The indices were stratified by stream length and each stratum was weighted by the estimated number of those streams in southeast Alaska. The products of the weighted means were summed to obtain a weighted mean index. The calculation was made using post stratification on non-proportional allocation of sampling (Sukhatme et al. 1984) as follows:

$$14) \quad \bar{x}_i = \Sigma x_i / n_i$$

$$15) \quad \bar{x}_w = \Sigma W_i \bar{x}_i$$

$$16) \quad V[\bar{x}_w] = \frac{(1 - n_i / N_i)}{n_i} \Sigma W_i^2 V[\bar{x}_i] + \frac{1}{n_i^2} \Sigma (1 - W_i) V[\bar{x}_i]$$

where:

$x_i$  = indices for stratum  $i$ ;  
 $n_i$  = number of index streams in stratum  $i$   
 $N_i$  = number of streams in the region that fall into stratum  $i$ ;  
 $N$  = number of streams in the region;  
 $y_i$  = the mean of indices in stratum  $i$ ;  $h$   
 $W_i$  = the stratum weight,  $N_i/N$

## RESULTS

### Overview of Commercial and Sport Harvests

The commercial and sport harvest of coho salmon in 1988 was significantly lower than in previous years. The commercial catch declined from an all-time high in 1986 of 3.3 million to 1.0 million in 1988 (Appendix Table 1). The total catch was 50% below the 1981 - 1987 average. The sport catch declined from about 46,000 to 35,500 (Appendix Table 2), a decrease of 23% relative to the 1977 - 1987 average. Decreased run size was not uniform within the region. In southern and central Southeast Alaska returns were poorest. In northern Southeast Alaska run strength was poor during the early season but improved in the later weeks of the season. In Yakutat, runs were near the all-time record high (ADFG 1989; Larson 1989).

The troll fishery has historically taken 60-65% of the regional catch of coho salmon (ADFG 1989). Because the majority of this harvest has occurred on outer coastal areas, the catch from the outside troll fishery has provided the first in-season indication of overall run strength of coho salmon. Based on poor early catches in this fishery, the Department closed the fishery from 25 July through 4 August. Upon reopening the fishery on August 5, the catch rates did not improve, and the fishery was closed again from 5 - 24 August. After mid-August, catches in test fisheries and from other fisheries indicated increased abundance of coho salmon in the inside waters and the troll fishery was opened from 25 - 31 August. Run strength through the end of August showed continued weakness in the southern and central areas of the region, while run strength in the northern areas and Yakutat improved substantially.

Net fisheries took 30%-40% of the regional catch of coho salmon, mostly during late August and September (ADFG 1989). Time-and-area closures were implemented to conserve coho salmon in District 108 (Stikine) and District 101 (Ketchikan). In District 115 (Lynn Canal), some time-and-area adjustments were made; no significant changes were made in District 111 (Taku/Snettisham). The catch of coho salmon in District 111 was 26% above the 1981 -1987 average and 17% higher than average in District 115.

Sport fisheries were restricted on 26 August through an emergency regulation which reduced the daily bag limit of coho salmon from 6 coho salmon to 2 fish per day. By 31 August, estimates of run strength had improved, and the emergency regulation was rescinded in all but the southern area of the region.

### Auke Lake

The estimated return of coho salmon to Auke Lake in 1988 was 1,196 adults. Of the return, an estimated 308 (estimated by quadrant by period) were taken in the troll fishery, 75 were taken in the gillnet fishery, and 48 were taken in the Juneau marine sport fishery for a total estimated harvest of 440 (Table 1). The estimated harvest rate was 36.8%; the historical average harvest rate was 40.7% (Table 2). The survival rate from smolt to age .1 adult was an estimated 18% and the survival rate to the total return i.e. jacks and adults was an estimated 21%. These survival rates were not different from previous years (Table 3).

A regression model [ $y = 733 + 1.658 (x)$ ] was developed to predict the return of age .1 adults based on returns of jacks a year earlier (Figure 3). Based on the escapement of 436 jacks in the 1988, the expected return of age .1 Auke Lake coho salmon in 1989 is 1,456. Assuming an average harvest rate of 41%, the escapement is expected to be about 859 age .1 adults.

### Chilkoot Lake

#### Adult Escapement:

The escapement of coho salmon to Chilkoot Lake spawning grounds was an estimated 1,525 adults. This value was obtained by subtracting the estimated sport harvest of 160 adults (Suchanek in press) from an escapement through the Chilkoot Lake weir of 1,685 (SE = 39) estimated using a bootstrap technique. One thousand four hundred and sixty age .1 coho salmon were counted at the Chilkoot Lake weir between 24 August and 12 November, 1988 (Table 4). From 5 October through 8 October, the weir was inoperable because of high water, and an unknown number of fish escaped upstream during this period, hence the need for an estimate (Table 5). Three hundred and thirty one fish were sampled for age, sex, and length data, and 240 (73%) had readable scales (Table 6). The mean length of the sample was 672 mm (SE = 3). Age 1.1 adults (1985 parent year) comprised 11.3% of the sample and age 2.1 adults (1984 parent year) comprised 78.8%, and age 3.1 adults (1983 parent year) was 10% of the sample.

#### Coded Wire Tagging:

Coded wire tags were injected into 2,949 juvenile coho salmon ranging from 65 mm - 110 mm fork length (tag code 04-28-26) between 9 September and 28 October 1988. Age and length data was collected from 243 juveniles. They averaged 79 mm long (SE = 1 mm) and 65% were age 0, 34.6% were age 1, and 0.4% were age 3 (Table 7).

### Eagle River

To estimate the abundance of pre-smolts, 287 juvenile coho salmon (> 85 mm) were captured with baited minnow traps and marked at upstream sites from 1 April - 15 April prior to the onset of emigration. From April to 27 May 1988, 3,573 fish >70 mm long were captured in fyke nets just above tide water (Table 8) of which 207 had been previously marked. The estimated abundance of pre-smolts was:

Table 1. 1988 estimated harvest of Auke Creek coho salmon by statistical week and period. There were 756 adults in the escapement of which 736 had coded wire tags for a tagged/untagged ratio of 0.9735.

Date	Stat.	Week	Per.	N Catch	n2 Sample	mc Tags	m1 Detected	m2 Decoded	a1 Ad Clip	a2 Heads	Est. Catch	SE
TROLL												
7/10 - 7/16	NE	29	3	3,578	2,560	1	9	9	12	12	1	1
7/17 - 7/23	NW	30	3	20,129	7,932	2	67	67	87	87	5	3
	SW	30	3	22,811	6,365	1	75	75	93	93	4	3
7/24 - 7/30	NW	31	3	13,716	5,796	4	44	44	49	49	10	4
8/07 - 8/13	NW	33	4	55,142	22,125	29	286	286	343	342	74	11
8/14 - 8/20	NW	34	4	38,600	20,089	21	258	258	303	297	42	7
	SW	34	4	8,520	4,703	1	47	47	58	58	2	1
8/21 - 8/27	NW	35	5	15,424	1,078	4	34	34	35	35	59	28
8/28 - 9/03	NW	36	5	56,657	29,205	27	393	393	460	450	55	8
	NE	36	5	4,646	1,260	1	13	13	18	18	4	3
9/04 - 9/10	NW	37	6	37,302	9,742	17	98	98	120	120	67	14
9/11 - 9/17	NW	38	6	12,123	8,573	6	41	41	57	57	9	2
	NE	38	6	2,107	1,380	1	3	3	5	5	2	1
9/18 - 9/24	NW	39	6	489	853	1	5	5	6	6	1	1
Total troll/Statwk				291,244	121,661	116	1,373	1,373	1,646	1,629	334	36
6/26 - 7/30	NE	3		14,455	7,052	1	44	44	56	56	2	2
	NW	3		53,459	18,337	6	149	149	181	171	19	6
	SW	3		62,684	22,259	1	209	209	270	265	3	2
7/31 - 8/20	NW	4		108,312	42,456	50	552	552	653	647	132	15
	SW	4		41,121	12,716	1	136	136	172	170	3	3
8/21 - 9/03	NW	5		72,081	30,283	31	427	427	495	483	78	11
	NE	5		6,998	1,858	1	14	14	19	19	4	3
8/28 - 9/24	NW	6		49,914	19,167	24	143	143	182	182	64	10
	NE	6		5,863	2,522	1	8	8	10	10	2	2
Total troll/period				414,887	156,650	116	1,682	1,682	2,038	2,003	308	23

Continued



Table 1. 1988 estimated harvest of Auke Creek coho salmon by statistical week and period. There were 756 adults in the escapement of which 736 had coded wire tags for a tagged/untagged ratio of 0.9735 (continued).

Date	Area	Stat. Week Per.	N Catch	n2 Sample	mc Tags	m1 Detected	m2 Decoded	a1 Ad Clip	a2 Heads	Est. Catch	SE
Gillnet											
7/03 - 7/09	106	28	753	247	1	2	2	2	2	3	3
8/21 - 8/27	115	35	5,305	2,412	1	3	3	5	5	2	2
8/28 - 9/03	111	36	13,038	6,400	3	89	89	103	103	6	3
9/04 - 9/10	115	37	17,600	4,847	6	28	28	36	35	23	8
	111	37	14,365	3,215	1	66	66	75	75	5	4
9/11 - 9/17	115	38	19,317	4,088	6	21	21	24	24	29	11
9/18 - 9/24	115	39	12,648	1,993	1	9	9	11	11	7	6
Total gillnet			83,026	23,202	19	218	218	256	255	75	16
SEINE											
8/14 - 8/20	112	34	5,835	1,634	1	4	4	4	4	4	3
8/21 - 8/27	112	35	695	364	1	1	1	1	1	2	0
8/28 - 9/03	112	36	3,094	993	1	5	5	7	7	3	3
Total seine			9,624	2,991	3	10	10	12	12	9	4
Juneau Marine Sport <sup>1</sup>											
7/31 - 8/06	32	16	3,369	1,672	3	13	13	13	13	6	3
8/14 - 8/20	34	17	4,524	729	1	11	11	11	11	19	10
8/21 - 8/27	35	17			2						
8/28 - 9/03	36	18	1,785	366	2	7	6	10	10	23	11
9/04 - 9/10	37	18			2						
Total Sport					10					48	15
Total Harvest (estimated by period by quadrant)										440	32

<sup>1</sup> Estimates of sport catch are for bi-weekly strata, based on the sum of the tags recovered in each statweek.

Table 2. Harvest rates of Auke Lake coho salmon by various fisheries, 1980 - 1988. Troll estimates are by statistical week.

Year	Troll		Drift Gillnet		Purse Seine		Marine Sport		Total Harvest		Escapement	Total Return
1980	199	21.1%	29	3.1%	0	0.0%	16	1.7%	244	25.9%	698	942
1981	279	27.7%	31	3.1%	9	0.9%	9	0.9%	328	32.6%	678	1,006
1982	142	19.4%	24	3.3%	117	15.9%	3	0.4%	286	39.0%	447	733
1983	403	33.0%	33	2.7%	8	0.7%	83	6.8%	527	43.1%	695	1,222
1984	414	33.7%	121	9.9%	0	0.0%	43	3.5%	578	47.1%	648	1,226
1985	514	32.1%	71	4.4%	3	0.2%	72	4.5%	660	41.2%	942	1,602
1986	398	41.5%	68	7.1%	0	0.0%	38	4.0%	504	52.7%	453	957
1987	437	36.2%	79	6.5%	0	0.0%	23	1.9%	539	44.7%	668	1,207
1988	308	25.8%	75	6.3%	9	0.8%	48	4.0%	440	36.8	756	1,196
Mean	344	30.7%	59	5.3%	16	1.4%	37	3.3%	456	40.7	665	1,121

Table 3. Estimated Auke Lake coho salmon return, smolt production, and smolt survival, 1976 - 1988.

Year	Number Tagged	Smolt Count	Total Commerical Harvest	SE	Sport Harvest	Escapement				Return w/jacks		Return wo/jacks	
						Adults		Jacks		Ocean		Ocean	
						Marked	Unmarked	Marked	Unmarked	Number	Surv.	Number	Surv.
1976	2,992												
1977	3,038					267	618	292	524				
1978						129	570	21	256				
1979	3,872					30	566	12	95				
1980	9,821	9,951	228	60	16	306	392	244	50	1,049	27%	942	24%
1981	6,372	7,140	319	42	9	624	54	203	28	1,300	13%	1,006	10%
1982	6,245	6,607	283	66	3	417	30	335	3	964	15%	733	12%
1983	6,115	6,721	444	37	83	630	64	224	37	1,559	25%	1,221	20%
1984	6,731	7,036	535	42	43	614	34	304	11	1,487	24%	1,226	20%
1985	5,502	5,601	588	43	72	937	5	117	2	1,917	28%	1,602	24%
1986	5,489	5,666	466	51	38	428	25	237	19	1,076	20%	957	17%
1987	6,868	7,181	516	39	23	668	-	206	-	1,463	27%	1,207	22%
1988	7,628	7,893	418	39	48	736	20	430	6	1,439	21%	1,196	18%
Mean	5,436	7,088	419	-	37	482	198	219	86	1,357	22%	1,121	18%
SD		1,223	167		27	255	245	117	149	282	8%	233	5%

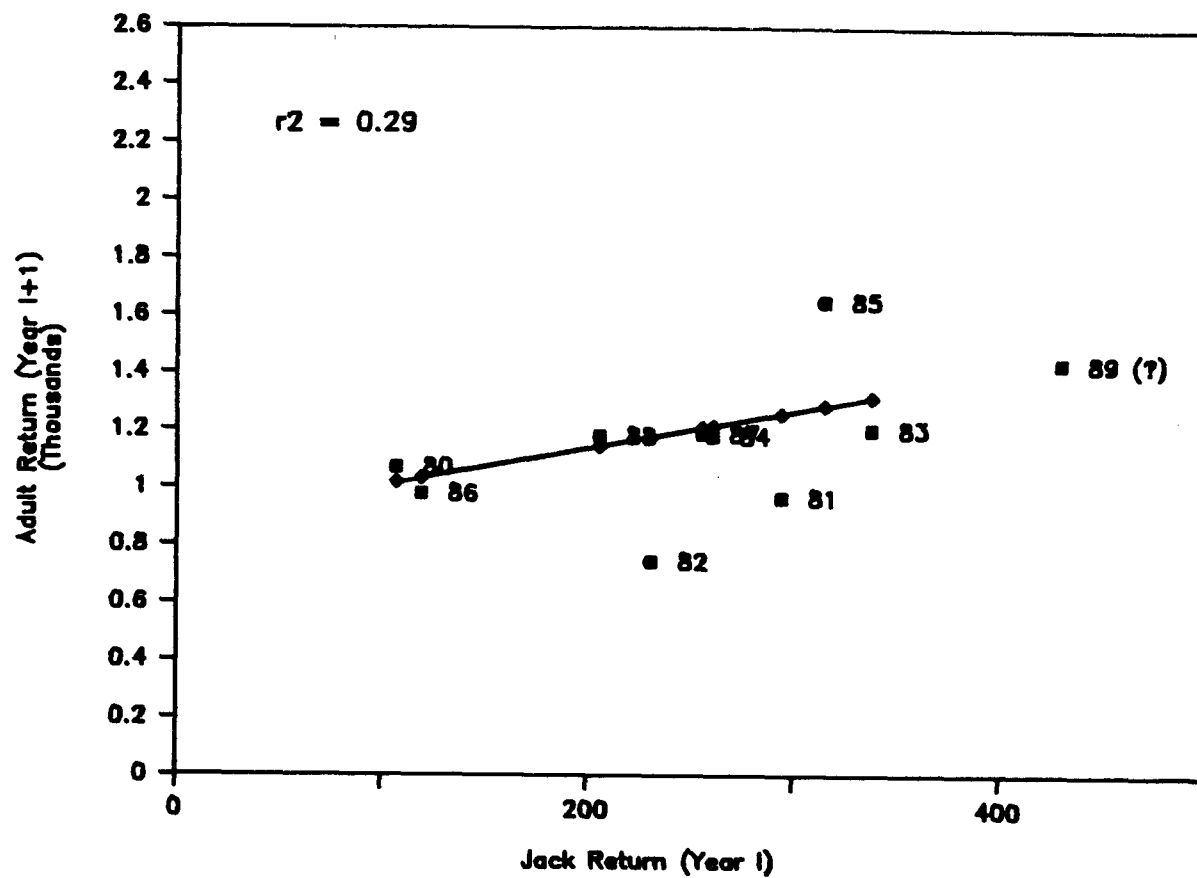


Figure 3. Return of age .1 Auke Lake coho salmon in year (i + 1) as predicted by the return of jacks in year i.

Table 4. Daily counts of age .1 adult coho salmon, water temperature, and water depth at Chilkoot Lake weir, 24 August - 12 November 1988.

Date	Daily Count	Cumulative (1,460)	Temp. (°C)	Depth <sup>1</sup> (cm)
24 AUG	1	1	7.2	50.0
25 AUG	0	1	7.8	50.0
26 AUG	0	1	8.3	51.5
27 AUG	0	1	7.8	53.0
28 AUG	0	1	7.8	55.0
29 AUG	0	1	7.8	56.0
30 AUG	0	1	7.8	56.0
31 AUG	0	1	7.2	56.5
1 SEP	0	1	7.8	68.0
2 SEP	0	1	6.7	60.0
3 SEP	1	2	7.8	51.0
4 SEP	1	3	7.8	49.0
5 SEP	2	5	7.8	51.5
6 SEP	4	9	7.8	47.5
7 SEP	4	13	7.8	41.5
8 SEP	3	16	7.8	35.0
9 SEP	1	17	7.8	31.5
10 SEP	6	23	7.8	28.0
11 SEP	11	34	7.2	32.5
12 SEP	7	41	7.2	50.5
13 SEP	9	50	7.2	49.5
14 SEP	2	52	7.2	44.0
15 SEP	15	67	7.2	36.0
16 SEP	13	80	6.7	33.0
17 SEP	14	94	7.2	26.0
18 SEP	3	97	7.2	23.0
19 SEP	3	100	7.8	22.0
20 SEP	21	121	7.2	23.5
21 SEP	18	139	6.7	25.0
22 SEP	13	152	6.7	26.0
23 SEP	40	192	6.7	29.5
24 SEP	49	241	7.2	27.5
25 SEP	56	297	7.2	24.0
26 SEP	39	336	5.6	20.0
27 SEP	58	394	6.7	19.5
28 SEP	60	454	6.7	21.0
29 SEP	113	567	7.2	24.0

continued

Table 4. Daily counts of age .1 adult coho salmon, water temperature, and water depth at Chilkoot Lake weir, 24 August - 12 November 1988. (continued).

Date	Daily Count	Cumulative (1,460)	Temp. (°C)	Depth <sup>1</sup> (cm)
30 SEP	100	667	6.7	29.0
1 OCT	63	730	6.7	29.0
2 OCT	120	850	7.2	22.0
3 OCT	125	975	7.2	27.0
4 OCT	98	1,073	7.2	47.0
5 OCT	weir out	1,073	7.2	79.0
6 OCT	-	1,073	6.7	79.0
7 OCT	-	1,073	6.7	85.0
8 OCT	-	1,073	6.7	64.0
9 OCT	6	1,079	7.8	57.0
10 OCT	6	1,085	7.2	56.0
11 OCT	10	1,095	7.2	51.0
12 OCT	19	1,114	7.2	53.0
13 OCT	18	1,132	6.1	52.0
14 OCT	11	1,143	6.1	50.0
15 OCT	19	1,162	6.1	44.0
16 OCT	18	1,180	6.7	38.0
17 OCT	23	1,203	6.1	35.0
18 OCT	13	1,216	6.1	30.0
19 OCT	37	1,253	6.1	29.0
20 OCT	14	1,267	6.1	26.0
21 OCT	12	1,279	5.6	24.0
22 OCT	11	1,290	5.6	22.0
23 OCT	8	1,298	5.6	21.5
24 OCT	15	1,313	6.1	19.5
25 OCT	13	1,326	4.4	19.5
26 OCT	21	1,347	5.0	18.0
27 OCT	21	1,368	5.0	16.0
28 OCT	13	1,381	5.0	14.0
29 OCT	weir out	1,381	5.0	12.0
30 OCT	2	1,383	5.0	10.0
31 OCT	3	1,386	5.0	11.0

Continued

Table 4. Daily counts of age .1 adult coho salmon, water temperature, and water depth at Chilkoot Lake weir, 24 August - 12 November 1988. (continued).

Date	Daily Count	Cumulative (1,460)	Temp. (°C)	Depth <sup>1</sup> (cm)
1 NOV	5	1,391	5.6	10.0
2 NOV	11	1,402	5.0	9.5
3 NOV	3	1,405	5.0	8.5
4 NOV	1	1,406	5.0	7.0
5 NOV	1	1,407	4.4	7.0
6 NOV	4	1,411	3.9	5.0
7 NOV	8	1,419	5.0	4.0
8 NOV	10	1,429	4.4	4.0
9 NOV	17	1,446	5.0	4.0
10 NOV	5	1,451	5.0	3.0
11 NOV	9	1,460	4.4	3.5
12 NOV	0	1,460	4.4	3.0
Total		1,460		

<sup>1</sup> Twenty-five cm were added to each water level to compensate for negative values

Table 5. Data used to compute a bootstrap estimate of the 1988 coho salmon escapement to Chilkoot Lake.

Year	10/5 - 10/8 (Date of missing 1988 data) $X_1$	Sum of Tails $X_2$	Total Count $X_1+X_2$	$p_i$ of Tails to Total $[X_2/(X_1+X_2)]$	Estimated 1988 Escapement $1,460/p_i$
1976	73	873	946	0.922	1,584
1978	147	888	1,035	0.857	1,704
1979	50	849	899	0.944	1,547
1983	319	1,520	1,839	0.826	1,768
1985	422	1,766	2,188	0.807	1,809
1986	246	1,705	1,951	0.873	1,672
Bootstrap results:					
Estimated escapement			= 1,685		
Variance			= 1,492		
SE			= 39		
N (number of bootstrap trials)			= 100		
1988 count			= 1,460		



Table 6. Mean length (mm mid-eye to fork), age, and sex composition of non-jack adult coho salmon sampled at Chilkoot Lake weir, 24 August - 12 November 1988.

		Parent Year			TOTAL
		1985	1984	1983	
		1.1	2.1	3.1	
Male	Sample Size	19	112	16	147
	Mean Length	654	679	666	674
	SD	77	43	31	48
	SE	18	4	8	4
	Percent Comp.	7.9	46.7	6.7	61.3
	SE (%)	5.8	4.3	5.9	3.7
Female	Sample Size	8	77	8	93
	Mean Length	664	668	676	668
	SD	29	28	27	27
	SE	10	3	9	3
	Percent Comp.	3.3	32.1	3.3	38.7
	SE (%)	6.2	4.9	6.2	4.6
Total	Sample Size	27	189	24	240
	Mean Length	669	673	670	672
	SD	24	44	29	41
	SE	5	3	6	3
	Percent Comp.	11.3	78.8	10.0	100
	SE (%)	5.7	2.7	5.7	0

Table 7. Mean fork length and age of juvenile coho salmon sampled at Chilkoot Lake, 27 September - 28 October 1988.

	Age 0	Age 1	Age 2	TOTAL
Sample Size	158	84	1	243
Mean Length	71	93	112	79
SD	8	10	-	14
SE	1	1	-	1
Percent Comp.	65.0	34.6	0.4	100
SE (%)	3.6	5.0	-	0

$$\frac{(3,573 + 1)(287 + 1)}{(207+1)} - 1 = 4,948; SE = 175$$

Two hundred and forty five of the smolt were sampled for length and age (Table 9). Two percent of the sample were age 1, 65.7% were age 2, and 31.4% were age 3.

Coho salmon smolts captured in the fyke nets were coded-wire tagged beginning on 27 April (Table 10). In the beginning of the study, only smolts >85 mm fork length were tagged. After 11 May, it became apparent that many of the smaller fish were actually smolt, and thereafter all fish >70 mm fork length were given coded wire tags. By 27 May, 2,628 smolt were tagged, with a post-tagging mortality of 7 for a valid release of 2,621.

#### Nahlin River

##### 1988 Adult Return:

The estimated return of Nahlin River coho salmon was 2,873. The troll fishery caught 4% of the return, the drift gillnet fishery caught 19% (primarily in district 111), the purse seine fishery took 1%, and the Juneau marine sport fishery caught 10%, and the Canadian in-river setnet fishery took 19% (Table 11). The harvest rate was 54% of the return. Most of the harvest in American waters took place in the District 111 drift gillnet fishery between 17 July - 23 July (statistical week 30) and in the Juneau marine sport fishery between 3 - 9 July (statistical week 28) (Table 12). The 1988 recoveries were from 4,872 juveniles coded wire tagged in August 1986. Of these, only 11 were recovered in the fisheries. This recovery rate resulted in estimates of harvest with unacceptably high standard errors. Obviously, more juveniles or smolts need to be tagged to improve the precision of the estimated harvest.

##### Adult Escapement:

One thousand three hundred and twenty two (1,322) adult coho salmon were counted at the weir on the Nahlin River from 25 July to 23 September 1988. The first migrant appeared 1 August and the run peaked on 4 September when 233 fish were counted. An additional peak occurred on 22 September after which the weir was removed (Table 13). Four hundred and eighty four fish were sampled for information on age and length; 391 of the samples had sets of readable scales. Age 1.1 adults comprised about 7% of the sample and averaged 584 mm long, age 2.1 adults comprised 92% of the sample and averaged 630 mm long, and age 3.1 adults comprised 1% of the sample and averaged 676 mm long (Table 14). No jacks (age .0) were found in the sample even though the picket spacing of the weir was designed to retain and catch jacks.

##### Juvenile Tagging:

During August 1988, 6,546 juvenile coho salmon were tagged with CWTs in the Nahlin River with the following tag codes:

Table 8. Daily smolt catches, water temperature, and stream depth at the Eagle River fyke station, 21 April to 27 May 1988.

Date	Average Water Temp. (°C)	Maximum Stream Depth (cm)	Number Coho	Number Steelhead	Number Dolly Varden
21 Apr	3.0		0	0	
24 Apr			32	0	17
25 Apr	5.0		23	0	54
26 Apr	5.0		15	1	67
27 Apr			51	0	57
28 Apr	5.0		146	5	181
29 Apr	5.2		77	3	126
30 Apr	5.0		75	2	117
01 May	5.5		68	0	75
02 May	2.0		54	1	70
03 May	2.0		43	0	72
04 May	5.0		60	0	107
05 May			103	0	110
06 May	5.0	22	114	2	122
07 May	6.0	23	117	3	165
08 May	6.5	24	128	1	69
09 May	7.5	26	142	4	39
10 May	6.5	27	426	20	54
11 May	7.5	26	250	10	44
12 May	7.0	39	300	30	83
13 May	7.5	34	430	10	19
14 May	6.5	42	377	26	38
15 May	6.0		104	5	8
16 May	7.5	24	45	1	3
17 May	6.5	23	48	0	6
18 May	6.5	28	85	5	3
19 May	7.0	54	244	15	12
20 May	6.0	70	125	18	9
21 May	6.5	34	81	16	6
22 May	7.0	32	13	5	5
23 May	6.0	38	11	3	3
24 May	6.5	40	60	10	4
25 May		29	26	1	1
26 May	7.0	25	25	0	2
27 May	7.0	27	21	3	2

Table 9. Mean fork length and age composition of coho salmon smolts sampled at Eagle River, 11 May to 27 May 1988.

	Age 1	Age 2	Age 3	Age 4	Total
N	5	161	77	2	245
Mean Length	75	81	93	111	85
SD	11	8	11	6	11
SE	5	1	1	5	1
Percent Comp.	2.0	65.7	31.4	0.8	100.0
SE (%)	6.8	3.6	5.1	8.7	-

Table 10. Coded-wire tagging summary of coho salmon smolt at the Eagle River fyke station, 24 April to 27 May 1988.

Date	Number of New Tags	Post-tagging Mortalities
27 Apr	10	0
28 Apr	65	0
29 Apr	34	0
30 Apr	35	0
01 May	30	0
02 May	24	0
03 May	19	0
06 May	99	0
07 May	52	1
08 May	57	0
09 May	63	0
10 May	178	0
11 May	212	0
12 May	273	0
13 May	399	0
14 May	340	0
15 May	99	0
16 May	39	0
17 May	42	0
18 May	72	0
19 May	226	0
20 May	107	6
21 May	69	0
22-23 May	39	0
24 May	20	0
25-26 May	14	0
27 May	11	0
Totals	2,628	7

Table 11. Estimated catch, SE, and harvest rate of the 1988 Nahlin River coho salmon in the various fisheries (ND = not determined).

Fishery	Catch (SE)	Harvest Rate
Troll	119 (118)	4%
Drift Gillnet		
Dist. 111	436 (194)	15%
Dist 115	115 (114)	4%
Subtotal	551 (225)	19%
Purse Seine	35 ( 35)	1%
Juneau Marine Sport	294 (171)	10%
Canadian In-river Setnet	552 (ND) <sup>1</sup>	19%
Total Harvest	1,551 ( ND)	54%
Escapement	1,322 ( - )	46%
Total Return	2,873 ( ND)	100.0%

<sup>1</sup> Estimate based on recovery of fish tagged with spaghetti tags at Canyon Island and recovered in the setnet fishery and at Nahlin River weir. Methods are discussed in Shaul (In press).

Table 12. Estimated catch of Nahlin River coho salmon by period and statistical week (tag code = 4-24-59). There were 1,322 adults in the escapement and 1,265 were examined for adipose fin clips, of which 31 were clipped for a tag/untagged ratio of 0.024 (SE = 0.001).

Date	Area/ Quad.	Stat. Week Per.	N Catch	n2 Sample Pi	mc Tags Detected	m1 Detected	m2 Decoded	a1 Ad Clip	a2 Heads	Est. Catch	SE
TROLL											
6/26 - 7/30	NW	- 3	53,459	18,337	1	148	148	180	180	119	118
Tot/period			53,459	18,337	1	148	148	180	180	119	118
GILLNET											
7/03 - 7/09	115	28	343	122	1	2	2	2	2	115	114
7/17 - 7/23	111	30	767	348	4	4	4	4	4	360	178
8/07 - 8/13	111	33	1,371	732	1	7	7	9	9	76	76
Total/week			2,481	1,202	6	13	13	15	15	551	225
SEINE											
7/17 - 7/23	109	30	89	103	1	3	3	3	3	35	35
Total/week			89	103	1	3	3	3	3	35	36
Juneau Marine Sport Fishery <sup>1</sup>											
7/03 - 7/09		28	14 538	207	1	2	2	2	2	212	150
7/10 - 7/16		29	14		1						
7/31 - 8/06		32	16 3,369	1,672	1	13	13	13	13	82	82
					3	11	11			294	171
Total harvest										999	308

<sup>1</sup> Estimates of sport catch are for bi-weekly strata, based on the sum of the tags recovered in each statweek.



Table 13. Daily counts of age .1 adult coho salmon, water temperature, and water depth at the Nahlin River weir, 25 July - 23 September 1988.

Date	Adult Coho Salmon				Temp (°C)	Depth (cm)
	Not Clipped	Adipose Clipped	Daily Total	Cum. (1,322)		
25 JUL	0	0	0	0	-	-
26 JUL	0	0	0	0	-	-
27 JUL	0	0	0	0	-	75.0
28 JUL	0	0	0	0	12.0	74.0
29 JUL	1	0	1	1	12.0	73.0
30 JUL	0	0	0	1	11.0	71.0
31 JUL	0	0	0	1	10.0	70.0
1 AUG	0	0	0	1	11.0	69.5
2 AUG	0	0	0	1	12.0	67.5
3 AUG	0	0	0	1	13.0	67.0
4 AUG	0	0	0	1	12.0	67.0
5 AUG	0	0	0	1	12.0	66.0
6 AUG	1	0	1	2	12.0	66.0
7 AUG	0	0	0	2	11.0	65.0
8 AUG	0	0	0	2	12.0	66.0
9 AUG	4	0	4	6	11.0	71.0
10 AUG	1	0	1	7	12.0	70.0
11 AUG	2	1	3	10	11.0	68.0
12 AUG	0	0	0	10	12.0	66.0
13 AUG	0	0	0	10	12.0	67.0
14 AUG	9	1	10	20	11.0	69.0
15 AUG	0	0	0	20	11.5	70.0
16 AUG	9	0	9	29	11.5	67.0
17 AUG	17	0	17	46	12.0	65.0
18 AUG	16	0	16	62	12.0	63.0
19 AUG	26	0	26	88	12.0	64.0
20 AUG	20	0	20	108	10.5	64.0
21 AUG	7	0	7	115	9.5	63.0
22 AUG	6	0	6	121	9.5	62.0
23 AUG	37	0	37	158	9.5	62.0
24 AUG	3	0	3	161	10.0	60.0
25 AUG	51	1	52	213	-	-
26 AUG	16	0	16	229	11.0	59.0
27 AUG	62	1	63	292	11.0	58.0
28 AUG	39	2	41	333	12.0	58.0
29 AUG	28	0	28	361	10.5	59.0
30 AUG	14	1	15	376	10.0	58.0
31 AUG	8	0	8	384	9.0	58.0

continued

Table 13. Daily counts of age .1 adult coho salmon, water temperature, and water depth at the Nahlin River weir, 25 July - 23 September 1988 (continued).

Date	Adult Coho Salmon				Temp (°C)	Depth (cm)
	Not Clipped	Adipose Clipped	Daily Total	Cum (1,322)		
1 SEP	84	0	84	468	9.0	58.0
2 SEP	53	1	54	522	8.5	58.0
3 SEP	48	1	49	571	9.0	59.0
4 SEP	228	5	233	804	11.0	58.0
5 SEP	40	3	43	847	11.0	57.5
6 SEP	15	0	15	862	8.0	58.0
7 SEP	2	1	3	865	8.0	57.5
8 SEP	2	0	2	867	8.0	57.0
9 SEP	1	0	1	868	6.5	56.0
10 SEP	2	0	2	870	6.5	56.0
11 SEP	4	0	4	874	7.0	56.0
12 SEP	22	2	24	898	7.0	56.0
13 SEP	37	0	37	935	7.0	56.0
14 SEP	9	1	10	945	7.0	56.0
15 SEP	5	1	6	951	6.0	57.0
16 SEP	8	2	10	961	5.0	58.0
17 SEP	9	0	9	970	5.0	58.0
18 SEP	5	0	5	975	4.0	57.0
19 SEP	4	0	4	979	4.5	56.0
20 SEP	3	0	3	982	5.0	56.0
21 SEP	18	1	19	1,001	5.5	56.0
22 SEP	258	6	264	1,265	6.0	55.5
23 SEP	57	-	57	1,322		
TOTAL	1291	31	1,322	1,322	-	-

Table 14. Mean length (mm mid-eye to fork), age, and sex composition of non-jack adult coho salmon sampled at Nahlin River weir 25 July - 23 September 1988.

		Parent Year			TOTAL
		1985	1984	1983	
		1.1	2.1	3.1	
Male	Sample Size	20	205	4	229
	Mean Length	569	631	676	627
	SD	104	67	33	73
	SE	23	5	16	5
	Percent Comp.	5.1	52.4	1.0	58.6
	SE (%)	4.2	2.9	4.8	2.7
Female	Sample Size	7	155	0	162
	Mean Length	631	629	-	630
	SD	35	38	-	38
	SE	15	3	-	3
	Percent Comp.	1.8	39.6	-	41.4
	SE (%)	4.5	3.3	-	3.2
Total	Sample Size	27	360	4	391
	Mean Length	585	631	676	628
	SD	95	56	33	61
	SE	18	3	16	3
	Percent Comp.	6.9	92.1	1.0	100
	SE (%)	4.1	1.2	4.8	0

Code	Number Tagged	Dates	Ave. Length
04-28-23	1,647	26 Aug. - 17 Sept.	65 mm FL
04-28-24	4,899	26 Aug. - 17 Sept.	81 mm FL
Total	6,546		

Two hundred and fifty juveniles were sampled for length and age (Table 15). About 60% of the sample were age 0 juveniles and averaged 71.4 mm fork length and 31% were age 1 and averaged 94.6 mm fork length.

#### Redoubt Lake

##### Estimates of Presmolt Abundance:

Coded wire tags (tag code 04-25-27) were injected into 5,969 Redoubt Lake coho salmon pre-smolt (> 85 mm FL) in the fall of 1986 (Schmidt 1986). An additional 1,201 pre-smolt >85 mm FL were tagged in the lake in spring 1987 (code 04-26-25) and given a secondary mark to distinguish them from fish tagged the previous fall. Later, 6,916 coho salmon smolt were captured as they emigrated from the lake, of which 607 had been tagged in the fall for an estimate of fall pre-smolt abundance of:

$$\frac{(5,969 + 1) (6,916 + 1)}{(607 + 1)} - 1 = 67,918; SE = 2,491$$

An in-season estimate of spring pre-smolt abundance based on recapture of tags applied in the spring was not possible due to the low recapture rate of this mark in the Redoubt Lake smolt net. Instead, the estimate was calculated using the number of spring-tagged fish harvested as adults and sampled in the commercial catch in 1988. One hundred and fourteen CWTs from Redoubt Lake were recovered in the 1988 coho salmon troll fishery. Ninety seven (85%) carried the fall tag code and 17 (15%) carried the spring tag code. At the weir on Redoubt Lake, 605 adults were inspected for missing adipose fins and 70 clips were observed. Assuming that the proportions of tag codes in the escapement were the same as in the commercial catch, the abundance of pre-smolt tagged in the spring was:

$$\frac{(1,201 + 1) (606 + 1)}{[70 (0.14912) + 1]} - 1 = 63,680; SE \approx 17,000$$

The estimated smolt to adult survival rate was computed by dividing the estimated adult return by the estimated abundance of pre-smolt in the spring:  $5,784/63,680 = 9.1\%$ .

Table 15. Mean fork length and age composition of juvenile coho salmon sampled at Nahlin River, 26 August - 17 September 1988.

	Age 0	Age 1	Total
Sample Size	173	77	250
Mean Length	71	95	79
SD	10	12	15
SE	1	1	1
Percent Comp.	69.2	30.8	100
SE (%)	3.5	5.2	0

#### 1988 Adult Return:

During 1988, 3,307 adult coho salmon were counted at the weir on the outlet of Redoubt Lake (Table 16). Of these, 605 were inspected for adipose clips, and 70 clipped fish were observed. The harvest by the troll fishery (expanded by period/quadrant) was an estimated 2,499 (SE = 233) fish Table 17. The harvest by the seine fishery (expanded by period/quadrant) was an estimated 24 fish. The estimated return was the sum of the harvest and the escapement or 5,830 adults. The mean length, sex composition, and age composition of the fish sampled at Redoubt Lake is given in Table 18.

The tag return ratios of adults tagged as juveniles in the lake during fall 1986 and spring 1987 were compared. There were 97 random recoveries of fall tag code 4-25-27 from 5,969 tags for a return ratio of 0.01625. The return ratio for the spring code was 17 of 1,201, or 0.01415. These fractions are not significantly different ( $\chi^2 = 0.28$ ; df = 1;  $0.50 < P < 0.75$ ).

The troll fishery in the Sitka area was closed on August 31, thereby reducing the potential catch of coho salmon. Despite this closure, the harvest rate of Redoubt Lake coho salmon in the troll fishery was an estimated 2,499/5,830, or 42.9%. This compares closely to the troll fishery harvest rate of 44.9% for the 1988 return to Salmon Lake. The harvest rate of Redoubt Lake adults in the seine fishery was 24/5,830, or 0.4%. No recoveries were reported in the sport fishery.

Records of historical coho salmon escapements show that Redoubt Lake produces substantial numbers of fish (Table 19). This stock is not currently utilized by the sport fishery and has the potential for supporting increased fishing effort.

#### Salmon Lake

##### Estimated Escapement:

The escapement of coho salmon to Salmon Lake in 1988 was an estimated 680 adults. The estimate is the sum of: 1) 447 fish counted across the weir (Table 20); 2) 10 adults that swam over the weir on 11 September; 3) 124 fish that swam around the weir on 8 October; and 4) 99 fish counted downstream of the weir when it was removed on 18 October.

The largest daily count of coho salmon occurred on 28 September when 137 adults and 4 jacks passed the weir. Of the 447 adults examined at the weir, 253 (56.6%) had missing adipose fins. In addition, 13 jacks were counted, of which 6 (46.2%) had missing adipose fins. Table 21 presents the mean length, age, and sex composition of adult coho salmon at Salmon Lake in 1988.

##### 1988 Harvest and Contribution:

Table 16. Daily coho salmon escapement counts, water temperature, and stream depth at the Redoubt Lake weir, 1988.

Date	Average Water Temperature (°C)	Daily Maximum Stream Depth (cm)	Number Adult Coho	Total Number Adult Coho
30 July			1	1
31 July			0	1
1 Aug	14.5	30	2	3
2 Aug	13.0	28	0	3
3 Aug	13.5	27	0	3
4 Aug	13.5	38	7	10
5 Aug	14.0	34	5	15
6 Aug	15.0	29	0	15
7 Aug	14.0	26	0	15
8 Aug	14.5	28	0	15
9 Aug	13.5	27	1	16
10 Aug	13.5	25	0	16
11 Aug	14.0	22	1	17
12 Aug	14.0	18	9	26
13 Aug	14.5	17	2	28
14 Aug	14.5	17	3	31
15 Aug	17.0	14	3	34
16 Aug	15.5	13	4	38
17 Aug	14.5	11	7	45
18 Aug	14.5	10	0	45
19 Aug	15.5	11	7	52
20 Aug	15.5	10	1	53
21 Aug	15.5	11	1	54
22 Aug	15.5	13	3	57
23 Aug	15.5	13	0	57
24 Aug	14.5	12	0	57
25 Aug	14.5	11	0	57
26 Aug	15.0	11	3	60
27 Aug	14.5	11	9	69
28 Aug	15.0	12	7	76
29 Aug	15.5	14	4	80
30 Aug	14.5	16	12	92
31 Aug	14.5	58	18	110
1 Sept	14.0	68	67	177
2 Sept	14.0	67	28	205
3 Sept	14.5	51	66	271
4 Sept	14.0	42	65	336
5 Sept	14.0	35	15	351
6 Sept	14.5	30	88	439

Continued

Table 16. Daily coho salmon escapement counts, water temperature, and stream depth at Redoubt Lake weir, 1988.

Date	Average Water Temperature (°C)	Daily Maximum Stream Depth (cm)	Number Adult Coho	Total Number Adult Coho
7 Sept	14.5	23	33	472
8 Sept	13.5	19	21	593
9 Sept	14.5	16	111	704
10 Sept	13.5	12	21	725
11 Sept	13.5	77	229	954
12 Sept	13.0	71	132	1,086
13 Sept	13.5	86	145	1,231
14 Sept	12.5	71	82	1,313
15 Sept	12.5	56	60	1,373
16 Sept	13.0	44	124	1,497
17 Sept	12.5	34	125	1,622
18 Sept	11.5	27	212	1,834
19 Sept	12.0	20	57	1,891
20 Sept	12.0	19	139	2,030
21 Sept	11.5	36	118	2,148
22 Sept	11.5	47	256	2,404
23 Sept	11.5	49	180	2,584
24 Sept	10.5	40	0	2,584
25 Sept	11.5	32	133	2,717
26 Sept	11.0	26	57	2,774
27 Sept	11.0	29	74	2,848
28 Sept	9.0	39	101	2,949
29 Sept	9.0	76	84	3,033
30 Sept	9.0	85	30	3,063
1 Oct	9.0	74	22	3,085
2 Oct	9.5	61	20	3,105
3 Oct	10.0	50	3	3,108
4 Oct	10.0	55	32	3,140
5 Oct			167 <sup>1</sup>	3,307

<sup>1</sup> Coho counted below weir prior to weir being removed.



Table 17. The 1988 estimated harvest of Redoubt Lake coho salmon by the troll fishery by period. There were 3,307 adults in the escapement of which 605 were examined for adipose fin clips and the observed number of clips was 70 for a tagged/untagged ratio of 0.12.

Date	Quad.	Period	N Catch	n2 Sample	mc Tags	m1 Detected	m2 Decoded	a1 Ad Clip	a2 Heads	Est Catch	SE
7/03 - 7/30	NW	3	53,459	18,337	17	149	149	181	171	453	108
7/03 - 7/30	NE	3	14,455	7,052	1	44	44	56	56	18	17
7/03 - 7/30	SE	3	17,214	13,368	1	97	97	126	119	12	11
7/31 - 8/20	NW	4	108,312	42,456	57	552	552	653	647	1268	164
7/31 - 8/20	SW	4	41,212	12,716	1	136	136	172	170	28	28
8/21 - 9/03	NW	5	72,081	30,283	32	427	427	495	483	675	116
9/05 - 9/24	NW	6	49,914	19,167	2	143	143	182	182	45	31
Total			356,647	143,379	111	1,548	1,548	1,865	1,828	2,499	233

Table 18. Mean length (mm mid-eye to fork), age, and sex composition of non-jack adult coho salmon sampled at the Redoubt Lake weir, 30 July - 22 September 1988.

		Parent Year				Total
		1984	1983	1982	1981	
		2.1	3.1	4.1	5.1	
Male	N	50	78	38	1	167
	Mean Length	645	641	645	532	642
	SD	56	68	77	-	67
	SE	8	8	13	-	5
	Percent Comp.	12.3	19.2	9.3	0.2	41.0
	SE (%)	4.4	4.2	4.5	-	3.6
Female	N	41	125	67	7	240
	Mean Length	653	666	674	685	667
	SD	42	37	41	59	40
	SE	7	3	5	22	3
	Percent Comp.	10.1	30.7	16.5	1.7	59.0
	SE (%)	4.5	3.9	4.3	5.0	3.0
Total	N	91	203	105	8	407
	Mean Length	648	657	663	666	656
	SD	50	53	58	77	54
	SE	5	4	6	27	3
	Percent Comp.	22.4	49.9	25.8	2.0	100.0
	SE (%)	4.1	3.3	4.0	4.9	-

Table 19. Cumulative number of adult coho salmon counted at the Redoubt Lake weir, 1953 to 1955 and 1983 to 1988.

Date	1953	1954	1955	1982	1983	1984	1985	1986	1987	1988
July 22	52	27	16	19	2	0	0	0	13	0
23	52	29	16	20	2	0	0	1	13	0
24	52	34	16	22	2	0	0	3	14	0
25	52	61	16	22	2	0	0	6	15	0
26	55	81	19	23	5	0	0	6	19	0
27	56	120	19	23	5	0	1	10	21	0
28	61	130	26	26	6	5	1	16	21	0
29	67	152	26	28	6	12	1	16	21	0
30	67	168	27	31	7	12	1	19	24	1
31	69	187	34	31	7	35	2	19	26	1
Aug. 1	69	199	34	31	10	44	2	20	56	3
2	70	204	36	31	13	50	4	21	67	3
3	90	210	36	31	14	61	4	25	74	3
4	104	216	42	31	14	61	4	31	92	10
5	107	218	56	31	17	69	5	39	109	15
6	133	233	65	32	20	69	6	52	112	15
7	149	243	113	32	44	82	12	58	144	15
8	187	264	120	36	46	87	24	62	147	15
9	212	282	130	41	49	102	31	67	153	16
10	435	298	180	41	70	108	44	82	169	16
11	590	328	209	45	70	126	59	86	173	17
12	732	345	223	45	74	155	62	93	188	26
13	855	370	258	45	75	171	74	108	200	28
14	855	380	305	45	91	194	89	113	205	31
15	855	432	324	45	138	200	117	130	210	34
16	977	465	354	45	156	207	131	147	240	38
17	1,077	580	403	46	185	221	167	162	265	45
18	1,231	729	431	49	254	277	184	229	267	45
19	1,352	830	453	49	316	279	198	249	268	52
20	1,503	872	485	49	351	366	203	273		53
21	1,601	1,004	542	50	412	437	212	320		54
22	1,721	1,188	549	50	460	496	255	381		57
23	1,862	1,200	552		477	559	273	406		57
24	2,092	1,375	575		503	689	311	487		57
25	2,281	1,573	614		520	696	335	514		57
26	2,368	1,755	686		557	734	337	541		60
27	2,541	2,010	717		587	995	388	574		69
28	2,681	2,129	756		609	1,208	506	801		76
29	3,497	2,219	829		635	1,379				80
30	4,060	2,433	906		671	1,569				92
31	4,416	2,639	963		754	1,843				110

-Continued-

Table 19. Cumulative number of adult coho salmon counted at the Redoubt Lake weir, 1973 to 1955 and 1983 to 1988.

Date	1953	1954	1955	1982	1983	1984	1985	1986	1987	1988
Sept. 1	4,526	2,742	1,168		902	1,969				177
2	4,651	2,934	1,413		994	2,151				205
3	4,880		1,534		1,023	2,326				271
4	4,956				1,041	2,455				336
5	5,122				1,062	2,605				351
6	5,258				1,103	2,762				439
7	5,353				1,120	2,874				472
8	5,449				1,276	2,941				593
9	5,544				1,396	3,016				704
10	5,627				1,455	3,098				725
11	5,683				1,516	3,161				954
12	5,753				1,590	3,247				1,086
13	5,846				1,620	3,337				1,231
14	5,945				1,670	3,400				1,313
15	6,008				1,696	3,464				1,373
16	6,048				1,750	3,643				1,497
17	6,107				1,768	3,831				1,622
18	6,164				1,778	3,958				1,834
19	6,220				1,812	4,040				1,891
20	6,259				1,851	4,137				2,030
21	6,301				1,896	4,183				2,148
22	6,347				1,942	4,225				2,404
23	6,368				1,956	4,252				2,584
24	6,399				1,999	4,368				2,584
25	6,421				2,006	4,405				2,717
26	6,437				2,082	4,443				2,774
27	6,451				2,090	4,465				2,848
28	6,466				2,111	4,484				2,949
29					2,130	4,497				3,033
30					2,146	4,497				3,063
Oct. 1					2,156	4,578				3,085
2					2,211	4,614				3,105
3					2,213	4,632				3,108
4						4,659				3,140
5						4,672				
6						4,742				
7						4,807				
Totals	6,466	2,934	1,534	50	2,213	4,807	506	801	268	3,140

Table 20. Daily coho salmon escapement counts, water temperature, and stream depth at the Salmon Lake weir, 1988.

Date	Average Water Temperature (°C)	Maximum Stream Depth (m)	Number Adult Coho	Number Jack Coho
01 Sept	10	0.92	21	0
02 Sept	10	0.65	1	2
03 Sept	11	0.50	0	0
04 Sept	12	0.45	0	0
05 Sept	11	0.46	1	0
06 Sept	11	0.47	3	0
07 Sept	11	0.43	0	0
08 Sept	11	0.40	0	0
09 Sept	11	0.40	0	0
10 Sept	11	0.38	0	0
11 Sept	11	1.36 <sup>+1</sup>	10	1
12 Sept	10	0.68	14	2
13 Sept	10	0.99	50	1
14 Sept	10	0.60	15	0
15 Sept	10	0.50	6	0
16 Sept	10	0.46	3	0
17 Sept	10	0.41	0	0
18 Sept	9	0.39	0	0
19 Sept	9	0.39	0	0
20 Sept	9	0.46	0	0
21 Sept	8	0.70	27	0
22 Sept	8	0.73	30	0
23 Sept	8	0.63	1	0
24 Sept	9	0.48	2	0
25 Sept	9	0.42	0	0
26 Sept	9	0.38	0	0
27 Sept	9	0.39	0	0
28 Sept	7	0.85	137	4
29 Sept	8	1.03 <sup>2</sup>	2	0
30 Sept	8	0.84	49	0
01 Oct	8	0.57	8	1
02 Oct	8	0.46	0	0
03 Oct	9	0.40	2	0
04 Oct	10	0.57	4	0
05 Oct	8	0.52	6	2
06 Oct	9	0.73	44	0
07 Oct	8	0.66	3	0
08 Oct	8	1.20 <sup>2</sup>	0 <sup>3</sup>	

Continued

Table 20. Daily coho salmon escapement counts, water temperature, and stream depth at Salmon Lake weir, 1988.

Date	Average Water Temperature (°C)	Maximum Stream Depth (m)	Number Adult Coho	Number Jack Coho
09 Oct	9	0.70	1	0
10 Oct	9	0.55	0	0
11 Oct	8	0.53	5	0
12 Oct	8	0.59	1	0
13 Oct	7	0.75	0	0
14 Oct	8	0.73	0	0
15 Oct	7	0.67	0	0
16 Oct	6	0.75	0	0
17 Oct	7	0.89	0	0
18 Oct	7	0.59	0	0

<sup>1</sup> Exceeded measuring device. Weir overtopped. Trap box closed.

<sup>2</sup> Trap box remained closed during high water

<sup>3</sup> 124 coho counted around side of weir.

Table 21. Mean length (mm mide-eye to fork), age, and sex composition of non-jack adult coho salmon sampled at Salmon Lake weir, 1 September - 18 October 1988.

		Parent Year					Total
		1985	1984	1983	1982	1981	
		1.1	2.1	3.1	4.1	5.1	
Male	N	1	29	18	7	1	56
	Mean Length	708	636	664	683	600	651
	SD	-	89	59	48	-	76
	SE	-	17	14	18	-	10
	Percent Comp.	0.8	24.6	15.3	5.9	0.8	47.5
	SE (%)	-	7.4	7.9	8.8	-	6.7
Female	N		31	23	7	1	62
	Mean Length		663	685	689	742	675
	SD		26	36	31	-	33
	SE		5	7	12	-	4
	Percent Comp.		26.3	19.5	5.9	0.8	52.5
	SE (%)		7.3	7.7	8.8	-	6.3
Total	N	1	60	41	14	2	118
	Mean Length	708	650	676	686	671	664
	SD	-	65	48	39	100	58
	SE	-	8	7	10	71	5
	Percent Comp.	0.8	50.8	34.7	11.9	1.7	100.0
	SE (%)	-	5.9	6.8	8.2	11.7	-

The estimated total harvest of coho salmon bound for Salmon Lake was 630 fish. The commercial troll fishery caught an estimated 584 (SE = 46) adults (expanded by quadrant/period) and the purse seine fishery caught an estimated 16 adults. The Sitka marine sport fishery caught an estimated 30 Salmon Lake coho salmon. Total production was the sum of escapement (680), and harvests by the troll fishery (584), seine fishery (16), and sport fishery (30), or 1,310 fish. Harvest rates for each fishery are as follows: troll fishery, 45%; seine fishery, 1%; and sport fishery, 2%. The combined commercial harvest rate, 48%, is lower than last year's combined commercial harvest rate of 53.0% primarily because of in-season closures of the troll fishery. The majority of harvest came from District 113, the area immediately offshore of Baranof and Chichagof Islands; the peak catch occurred from 21 August - 27 August (statistical week 35) (Table 22).

#### Estimate of 1988 Smolt Abundance:

In August 1987, 2,268 juvenile coho salmon > 85 mm FL were tagged with CWTs and marked by removal of their adipose fin. From 3 March to 29 April 1988, 1,396 pre-smolts greater than > 85 mm FL were captured in baited minnow traps in Salmon Lake prior to emigration. Of these, 198 had been previously tagged in August 1987; the dorsal margins of the caudal fins of these fish were shallowly clipped. The remaining 1,198 (untagged) juveniles were given ventral caudal clips. This provided marked juveniles in the population to estimate the abundance of smolt at the time of emigration.

Emigrating smolt were captured in stream-type fyke nets and tagged with CWTs from 26 April through 19 May 1988. During this period, 7,283 coho salmon smolt were captured (Table 23). The age composition and length at age of the smolt population is presented in Table 24. There were 881 adipose fin clipped fish recaptured (fall CWT), 126 adipose fin/dorsal caudal clips recaptured (fall CWT and spring marked), and 723 ventral caudal clips (spring mark) recaptured. There were 6,269 CWTs inserted into untagged smolt with a post tagging mortality of 42 of these fish. There were 168 smolt that died after capture and prior to tagging.

There were 2,268 juvenile coho salmon tagged in the fall of 1987. Nine of these fish died from handling, and the remainder had a 95.91% tag retention for a valid release of 2,166 tags with code 04-28-44. This does not account for overwinter mortality. The release of 6,227 smolts tagged in the spring was assumed to have the same tag retention as the fall tagged fish (95.91%). This results in a net valid release of 5,972 smolts with tag code 04-28-60.

The abundance of juveniles in the fall was estimated from the recapture of fall-tagged fish during fyke net operations (26 April to 19 May). Seven thousand two hundred and eighty three smolt were captured, which included 881 of the original 2,268 fall-marked fish, for an estimated abundance of:

$$\frac{(2,259 + 1)(7,283 + 1)}{(881 + 1)} - 1 = 18,664; \text{ SE} = 460$$



Table 22. 1988 estimated harvest of Salmon Lake coho salmon by the troll fishery by quadrant/period. There were 680 adults in the escapement of which 447 were examined for adipose fin clips and 253 clips were observed for a tagged/untagged ratio of 0.57.

Date	Quad.	Period	N Catch	n2 Sample	mc Tags	m1 Detected	m2 Decoded	a1 Ad Clip	a2 Heads	Est. Catch	SE
7/03 - 7/30	NW	3	53,459	18,337	20	149	149	181	171	109	22
7/03 - 7/30	SW	3	62,684	22,259	2	209	209	270	265	10	6
7/03 - 7/30	NE	3	14,455	7,052	1	44	44	56	56	4	3
7/31 - 8/20	NW	4	108,312	42,456	58	552	552	653	647	264	31
8/21 - 9/03	NW	5	72,081	30,283	45	427	427	495	483	194	25
8/21 - 9/03	SW	5	12,210	5,912	1	78	78	89	89	4	3
Total			323,201	126,299	127	1,459	1,459	1,744	1,711	584	46

Table 23. Daily smolt catches, rainfall, water temperature, and maximum stream depth at the Salmon Lake fyke net station, 1988.

Date	Previous 24-Hour Rainfall (inches)	Mean Water Temp. (°C)	Maximum Stream Depth (cm)	Number of smolts		
				Coho	Sockeye	Steelhead
26 Apr	Trace	5.0	0.49	113	2	22
27 Apr	0.1	5.0	0.57	86	0	17
28 Apr	0.15	5.0	0.61	85	0	13
29 Apr	0.35	4.0	0.64	251	1	28
30 Apr	0.7	4.0	0.59	211	0	13
01 May	0.3	4.5	0.51	156	0	2
02 May	0.1	5.0	0.48	161	0	4
03 May	0.0	5.0	0.48	100	0	2
04 May	0.3	5.0	0.51	95	2	6
05 May	0.0	6.0	0.50	171	5	3
06 May	0.0	5.0	0.55	213	1	0
07 May	0.0	5.0	0.58	637	4	7
08 May	0.0	5.0	0.60	753	10	10
09 May	0.0	6.0	0.68	1,065	22	3
10 May	0.0	5.0	0.68	1,649	27	24
11 May	0.0	6.0	0.76	701	52	20
12 May	0.5	5.0	0.80	198 <sup>1</sup>	10	1
13 May		6.0	0.78	0 <sup>2</sup>		
14 May	0.35	5.0	0.70	0 <sup>2</sup>		
15 May	0.2	5.0	0.59	179	5	4
16 May	0.0	6.0	0.55	86	78	6
17 May	0.15	5.0	0.56	99	180	3
18 May	0.5	5.0	0.59	150	143	5
19 May	1.1	5.0	0.68	122	200	7

<sup>1</sup> Partial night of trapping. Nets pulled during high water.

<sup>2</sup> Not fished because of high water.

Table 24. Mean fork length and age composition of coho salmon smolts sampled at Salmon Lake, 26 April - 19 May 1988.

		Parent Year					Total
		1985	1984	1983	1982	1981	
		Age 2	Age 3	Age 4	Age 5	Age 6	
N		125	128	105	63	5	426
Mean Length		103	115	136	153	156	123
SD		11	16	16	10	11	22
SE		1	1	2	1	5	1
Percent Comp.		29.3	30.0	24.6	14.8	1.2	100.0
SE (%)		4.0	3.9	4.1	4.4	5.2	-

The abundance of smolt was estimated from the recapture of 849 fish (126 dorsal caudal and 723 ventral caudal) of the 1,396 fish originally marked in the lake prior to emigration as:

$$\frac{(1,396 + 1)(7,283 + 1)}{(849 + 1)} - 1 = 11,970; SE = 241$$

#### Sinitstin and St. Johns Creeks

The estimated abundance of juveniles in Sinitstin and St. Johns Creeks decreased in both streams. In St. Johns Creek, the number of age 1 juveniles was 53% less in 1988 than 1987; in Sinitstin Creek the number of age 1 juveniles was 8.3% less in 1988 (Schmidt 1988). The decrease in this age class was expected as only 9 adults were seen in St. John Creek and 4 adults were seen in Sinitstin Creek during escapement surveys in 1986, the dominant parent year. Table 25 summarizes estimates of abundance, length and age composition in both creeks for July 1987 and July 1988. Age composition of those juveniles > 65 mm FL in July is also listed.

#### Vallenar Creek

From 22 April to 7 June, 4,193 coho salmon smolt  $\geq 70$  mm were captured with fyke nets. Smolt were captured at the onset of numerous freshets and up to the time that the nets were overtopped. On 21 May, catches exceeded 600 fish per hour until the weir was breached. Daily catches, water levels, and temperature are listed in Table 26. Of the fish captured in the fyke nets, 4,108 coho salmon smolt  $\geq 70$  mm were adipose fin clipped and were tagged with the following CWT codes:

Tag Code	Number tagged	Dates	Ave. Length
04-28-42	4,002	12 May - 26 May	84 mm FL
04-28-45	106	2 June - 9 June	84 mm FL
Total	4,108		

Three hundred and ninety one smolt were sampled for age and length. Of these, 27.6% were age 1 and averaged 78 mm long, 70.8% were age 2 and averaged 87 mm long, and 1.5% were age 3 and averaged 104 mm long (Table 27).

The abundance of coho salmon smolt was estimated by capturing and marking pre-smolts  $\geq 70$  mm FL at upstream sites and recapturing them in downstream fyke nets. We marked 1,020 pre-smolts from 21 April to 7 May prior to any appreciable emigration. Of the 4,193 fish captured in the fyke nets, 356 were marked for an estimated abundance of:

$$\frac{(1,020 + 1)(4,193 + 1)}{(356 + 1)} = 11,994 \text{ smolt}; SE = 489$$

Table 25. Population estimates of juvenile coho salmon > 65 mm forklenght, Sinitsin and St. John Creeks near Sitka, 1987-1988.

	Sinitsin Creek		St. John Creek	
	1987 <sup>1</sup>	1988	1987 <sup>1</sup>	1988
M <sub>j</sub>	689	102	508	341
C <sub>j</sub>	437	68	446	236
R <sub>j</sub>	320	52	207	113
N <sub>j</sub> *	940	133	1,093	710
SE	19	6	42	39
% Age 0	0	0	0	4
% Age 1	98	57	94	77
% Age 2	2	43	6	19
No. Age 1	921	76	1,027	546

where M<sub>j</sub> = number of juvenile coho >65 mm marked.  
C<sub>j</sub> = number of juvenile coho >65 mm recaptured.  
R<sub>j</sub> = marked juvenile coho >65 mm recaptured.  
N<sub>j</sub> = number of juvenile coho >65 mm length.

<sup>1</sup> Schmidt (1988)

Table 26. Daily counts of coho salmon smolts, water temperature, and water depth at Vallenar Creek, 22 April - 7 June 1988.

Date	Daily Count	Cumulative (4,193)	Temp. (°C)	Depth (cm)
22 APR	0	0	4.0	24.5
23 APR	0	0	4.5	21.5
24 APR	0	0	4.0	20.0
25 APR	1	1	3.5	25.0
26 APR	0	1	5.0	24.0
27 APR	0	1	6.0	30.7
28 APR	weir out	1	-	-
29 APR	-	1	-	-
30 APR	-	1	-	-
1 MAY	-	1	-	-
2 MAY	-	1	-	-
3 MAY	10	11	4.5	29.0
4 MAY	12	23	5.0	26.5
5 MAY	4	27	4.5	24.5
6 MAY	1	28	5.0	25.5
7 MAY	19	47	6.0	25.5
8 MAY	31	78	6.0	25.5
9 MAY	37	115	6.0	24.0
10 MAY	29	144	6.0	24.0
11 MAY	106	250	8.0	28.5
12 MAY	58	308	8.0	25.5
13 MAY	149	457	8.0	31.5
14 MAY	28	485	6.5	23.5
15 MAY	5	490	6.0	18.5
16 MAY	74	564	7.5	18.5
17 MAY	670	1,234	7.0	26.5
18 MAY	315	1,549	6.5	36.5
19 MAY	155	1,704	6.5	38.5
20 MAY	40	1,744	6.5	22.0
21 MAY	1,806	3,550	7.5	35.0
22 MAY	weir out	3,550	7.5	45.0
23 MAY	13	3,563	7.5	28.0
24 MAY	4	3,567	7.5	15.0
25 MAY	61	3,628	7.5	13.5
26 MAY	456	4,084	7.5	35.0
27 MAY	16	4,100	8.0	72.0
28 MAY	weir out	4,100	8.5	28.0
29 MAY	9	4,109	7.0	23.0
30 MAY	69	4,178	7.0	67.5
31 MAY	weir out	4,178	7.5	54.0

Continued

Table 26. Daily counts of coho salmon smolts, water temperature, and water depth at Vallenar Creek, 22 April - 7 June 1988 (Continued).

Date	Daily Count	Cumulative (4,193)	Temp. (°C)	Depth (cm)
1 JUN	-	4,178	7.5	32.0
2 JUN	4	4,182	6.0	21.5
3 JUN	2	4,184	7.5	17.5
4 JUN	7	4,193	7.0	17.5
5 JUN	0	4,193	7.5	13.0
6 JUN	0	4,193	8.5	12.5
7 JUN	0	4,193	10.0	11.5
Total		4,193		

Table 27. Mean fork length and age composition of coho salmon smolts sampled at Vallenar Creek, 15 May - 19 May, 1988.

	Age 1	Age 2	Age 3	Total
Sample Size	108	277	6	391
Mean Length	78	87	104	85
SD	4	7	4	8
SE	0	0	1	0
Percent Comp.	27.7	71.8	1.5	100.0
SE (%)	4.1	2.6	5.2	-



## Yehring Creek

### Estimated 1988 Smolt Abundance:

The coho salmon smolt migration began in early May as indicated by low catches on 11 May. The migration peaked around 29 May with daily catches exceeding 1,000 smolt, and was essentially complete by 12 June (Table 28) when increasing numbers of smaller non-smolt juveniles were captured. During this period, 11,775 coho salmon smolt ( $\geq 70$  mm) were captured at the outfalls of six headwater beaver dams, transported to camp, adipose fin clipped, and tagged with CWTs, and released. The 24-hour tag retention tests resulted in a valid release of:

Tag Code	Valid Release	Date
04-27-08	9,870	17 May - 5 June
04-28-36	1,855	5 June - 9 June
Total	11,725	

The adipose fin clipped smolt were recaptured daily in a "lake-type" fyke net located about two km downstream of the release site for a estimated smolt abundance of:

$$\frac{(11,775 + 1)(278 + 1)}{(47 + 1)} = 68,448; SE = 8,879$$

where:

- M = 11,725, number of smolt marked and released at upstream sites;
- C = 278, number of smolt captured in a downstream fyke net;
- R = 47, number of marked smolt observed in the above sample of 278.

Based on the above, about 17% of the 1988 smolt run was tagged - thus about 17% of the 1989 adult return should be adipose clipped.

About 600 smolt were sampled for age and length analysis; about half were taken during the first week of the migration and the remainder during the last week of the migration (Table 29). The mean smolt length was 93 mm at the beginning of the season and 96 mm at the end of the season, values that were significantly different (t-test;  $P = 0.0006$ ). The proportions of age 1, age 2, and age 3 smolt were significantly different (chi - square;  $P > 0.001$ ) at the beginning and end of the smolt season with the oldest smolt leaving earlier. Therefore, increases in the mean size of smolt was attributed to growth of the year and not to older, "larger" fish leaving at the end of the season. The shift to younger fish at the end of the season suggests that younger smolt emigrated last or that mis-identification of juveniles as smolt occurred.

Table 28. 1988 Yehring Creek daily coho salmon smolt ( $\geq 70$  mm) catches and water temperature at different sites. These data are rough counts and may not agree with the number of fish coded-wire tagged. ND = no data.

Date	Camp Site			Jumpin J. Camp Dam		Hot Pond		Big Pond		Cold Ponds				Fyke Net		Total	
	H2O T. (°C)	Air T. (°C)	Dep (cm)	Catch (°C)	Temp (°C)	Catch (°C)	Temp (°C)	Catch (°C)	Temp (°C)	Catch (°C)	Temp (°C)	Catch (°C)	Temp (°C)	Marked	Nomark	Catch	Cum
MAY 11		10	146					17	16							17	17
MAY 12	4	11.5	146	3		23	4	42	15	10	9					78	95
MAY 13	4	11	158	15	9.5	41	4	28	12	5	5			0	2	91	186
MAY 14	4	9	171	15	8.5	24	4	79	ND	28	ND			0	1	147	333
MAY 15	5	8	164	17	8.5	7	4	99	11	20	6			0	ND	143	476
MAY 16	4	6.5	146	4	7.5	8	4	46	10.5	ND	8			0	ND	58	534
MAY 17	4.5	6	134	4	8.5	4	5.5	173	12	31	8			0	ND	212	746
MAY 18	5.5	7	126	6	8.5	3	5	132	12.5	20	8			2	16	177	923
MAY 19	5.5	7.5	121	3	7.5	3	4.5	19	12	6	8			1	1	32	955
MAY 20	5.5	7	118	15	8	5	ND	284	11.5	148	8	22	8	2	15	489	1,444
MAY 21	5	7	122	10	8	6	5	113	13	164	8.5	41	8.5	0	0	334	1,778
MAY 22	4.5	11	124	3	8			111	11.5	163	8	14	8.5	0	18	309	2,087
MAY 23	5.5	9	121	6	8			241	12	397	8	36	7	4	74	758	2,845
MAY 24	5.5	8	124	15	9			128	12	251	7	43	6	7	5.5	466	3,311
MAY 25	5.5	7	120	7	9			93	12.5	34	8.5	35	6.5	2	6	171	3,482
MAY 26	6	7	116	6	9			150	12	157	8.5	20	7	4	6	357	3,839
MAY 27	7	9	117	25	9.5			166	11.5	403	9	31	6.5	2	7	649	4,488
MAY 28	5.5	10.5	120	21	9.5			198	14	701	10	34	8	0	8	954	5,442
MAY 29	6	11	131	65	9.5			258	13.5	730	11	19	7	0	7	1,072	6,514
MAY 30	6.5	8	147	45	9			87	13.5	649	8	7	6.5	1	6.5	789	7,303
MAY 31	6.5	8	150	48	9			83	13	551	8	20	7	1	7	703	8,006

Continued

Table 28. 1988 Yehring Creek daily coho salmon smolt catches and water temperature at different sites (Continued). These data are rough counts and may not agree with the number of fish coded-wire tagged. ND = no data.

		Camp Site			Jumpin J. Camp Dam		Hot Pond		Big Pond		Cold Ponds				Fyke Net		Total		
		H2O T. (°C)	Air T. (°C)	Dep (cm)	Catch (°C)	Temp (°C)	Catch (°C)	Temp (°C)	Catch (°C)	Temp (°C)	Catch (°C)	Temp (°C)	Catch (°C)	Temp (°C)	Marked	Nomark	Catch	Cum	
JUN	1	7	8	131	61	9		70	13	344	8.5	8	7.5	0	7.5	1	2	485	8,491
JUN	2	8	8	124	11	10		12	13.5	228	9	2	8	0	8	2	6	259	8,750
JUN	3	7.5	9.5	122	15	10		20	14	187	11	8	10	1	11	0	1	232	8,982
JUN	4	7.5	12.5	123	47	10		62	14	668	9.5	12	8	0	9	9	18	807	9,789
JUN	5	7.5	13	128	64	9.5		16	12	452	9	6	8	3	8	13	7	548	10,337
JUN	6	8.5	13	141	32	10		15	15	324	10	7	8	2	8	2	3	383	10,720
JUN	7	8.5	14	164	7	10		25	17	221	9	5	9	0	9	ND	ND	258	10,978
JUN	8	8.5	16	176	86	10.5		18	16	311	8.5	0	8.5			0	0	415	11,393
JUN	9	8	14	182	80	10		20	16	122	7.5					0	0	222	11,615
JUN	10	8	11	186												1	1	1	11,616
JUN	11	7.5	10.5	181												0	2	2	11,618
JUN	12	7.5	10	179														0	11,618
TOTAL					736		124	2,805		7,325		370		27		47	231		11,618

Table 29. Mean fork length and age composition of coho salmon smolts sampled at Yehring Creek at the beginning and end of the smolt season, 1988.

Period	Age 1	Age 2	Age 3	Total
12 May - 18 May				
N	46	194	5	245
Mean length	76	97	109	93
SD	5	9	3	12
SE	1	1	1	1
Percent Comp.	18.8	79.2	2.0	100
SE (%)	5.0	2.5	6.1	-
6 June - 7 June				
N	135	204	1	340
Mean length	89	100	110	96
SD	6	7	-	9
SE	1	1	-	1
Percent Comp.	40.0	60.0	-	100
SE (%)	3.3	2.7	-	-
Total				
N	181	398	6	585
Mean length	84	94	106	95
SD	8	8	3	10
SE	1	0	1	0
Percent Comp	31	68	1	100
SE (%)	2.8	1.9	3.7	-

#### Adult Escapement:

Between 12 August and 23 October, 1,423 adult coho salmon were counted at the Yehring Creek weir. All fish were counted; there were no breaches of the weir. The early portion of the adult migration was poorly represented (Figure 4) compared to 1986 (Elliott 1987) and 1987 (Elliott and Kuntz 1988). This may be due to over-harvest of the early portion of the return, or to naturally occurring paucity in years when the return is not large. The rate of immigration built quickly beginning in late September, peaked on 6 October during high-water conditions, and rapidly diminished thereafter. Daily counts, plus records of water temperature and depth, are listed in Table 30.

Analysis of 457 samples showed that 384 contained readable scales. Of these, 18.8% were age 1.1 and averaged 654 mm long, 78.6% were age 2.1 and averaged 668.6 mm long, and 2.6% were age 3.1 and averaged 648 mm long (Table 31).

#### Estimated 1988 Harvest Rates and Contributions:

The estimated return of Yehring Creek coho salmon in 1988 was 6,200 (Table 32) of which 77% (SE = 2) was harvested by the various fisheries. Twenty eight percent were caught in the troll fishery (primarily in the northwest quadrant), 44% were caught in the drift gillnet fishery (primarily district 111), and 5% were caught in the Juneau Marine sport fishery.

High catch rates of Yehring Creek adults occurred in the troll fishery from 7 August to 3 September (statistical weeks 33-36), in the District 111 drift gillnet fishery from 28 August to 3 September (statistical week 36), and in Juneau's marine sport fishery during 21 - 27 August, (Table 33). The cumulative coefficient of variation (Table 34) indicates that no new or unexpected changes in variance of the catch is expected after 13 August (statistical week 33). This suggests that the cumulative catch by this date could be used to estimate the return of this stock with essentially the lowest measurement error possible.

#### Estimated Abundance and Ocean Survival of 1987 Smolt:

The abundance of coho salmon smolt leaving Yehring Creek in 1987 was estimated using the mark/unmarked ratio of adults observed at the Yehring Creek weir in 1988 as follows:

$$\frac{(5,187 + 1)(1,333 + 1)}{(88 + 1)} = 77,761 \text{ smolt; SE} = 7,850$$

where:

- M = 5,187, the number of CWT tagged smolt released in 1987;
- C = 1,333, the number of adults inspected for tags at the Yehring Cr. weir in 1988;
- R = 88, the number of adipose clipped adults observed in the sample of 1,333.

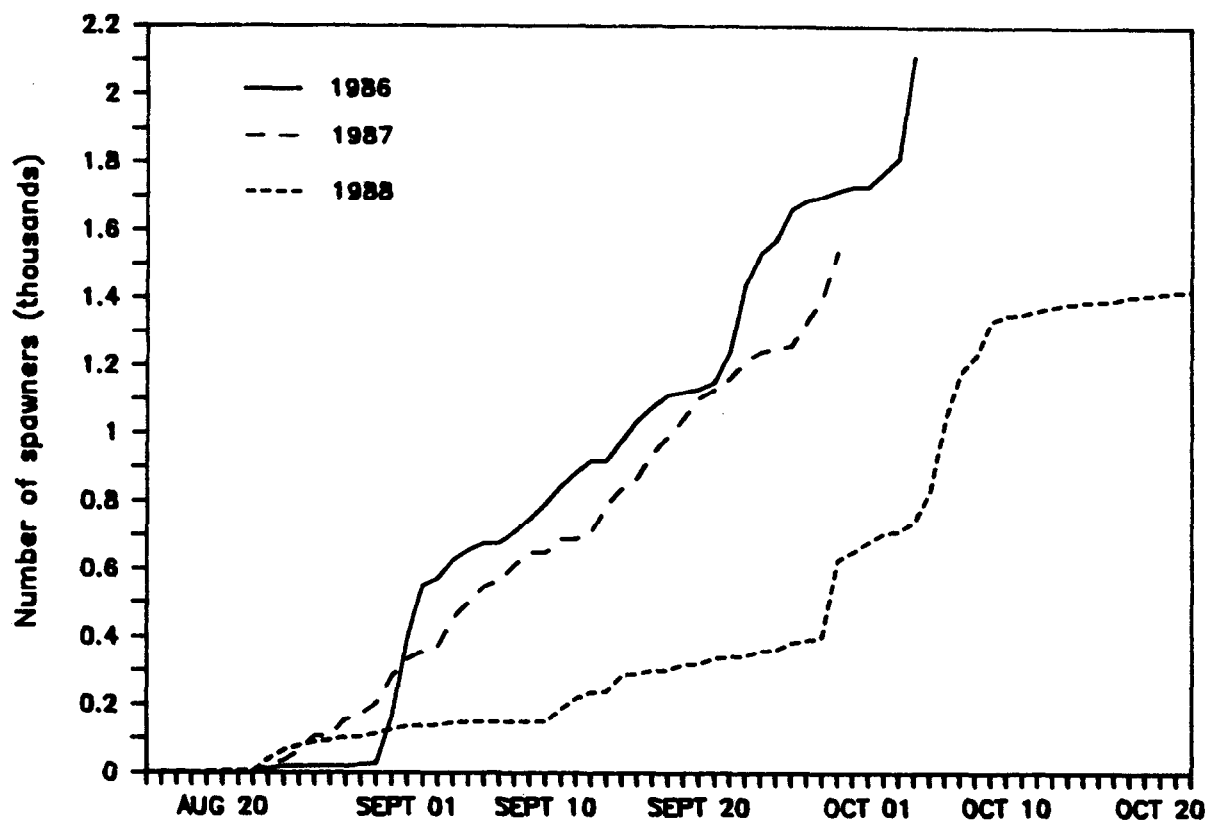


Figure 4. Cumulative number of adult coho salmon counted at the Yehring Creek weir, 1986 – 1988. (Counts in 1986 and 1987 are incomplete.)

Table 30. Daily counts of adult salmonids at Yehring Creek, Taku River, 1988.

Date	Water		Adult coho salmon						
	Temp. (oC)	Depth (cm)	Adip. Clip	Not Clipped	Counted Through	Sockeye	Pink	Chum	Dolly Varden
Aug 12	9	47	0	0	0	1	3	0	0
Aug 13	9	55	0	0	0	1	7	0	0
Aug 14	9	51	0	0	0	0	5	1	0
Aug 15	8	44	0	1	0	0	4	5	0
Aug 16	10	43	0	1	0	0	1	2	1
Aug 17	10	45	0	0	0	0	2	7	0
Aug 18	11	45	0	2	0	20	4	6	0
Aug 19	10	47	1	1	0	6	5	4	1
Aug 20	10	38	1	0	0	4	4	0	0
Aug 21	10	31	0	0	0	0	2	1	0
Aug 22	10	37	0	0	0	0	0	0	1
Aug 23	9	49	4	33	0	21	7	0	1
Aug 24	9	36	2	24	0	11	2	0	0
Aug 25	10	39	1	12	0	7	0	1	0
Aug 26	9	44	1	8	0	17	0	0	1
Aug 27	10	48	0	6	0	17	1	0	0
Aug 28	10	51	0	8	0	18	2	0	0
Aug 29	9	58	0	2	0	8	0	0	1
Aug 30	9	51	1	8	0	5	0	0	0
Aug 31	9	55	2	9	0	20	1	0	0
Sep 1	9	104	0	11	0	10	4	2	0
Sep 2	8	105	0	0	0	0	0	0	0
Sep 3	8	73	1	3	0	3	4	1	0
Sep 4	9	58	0	6	0	8	4	0	1
Sep 5	9	58	2	0	0	8	0	0	1
Sep 6	9	48	0	0	0	10	0	0	0
Sep 7	8	31	0	0	0	6	3	0	0
Sep 8	8	20	0	0	0	1	2	1	0
Sep 9	8	14	1	0	0	0	0	0	0
Sep 10	9	9	0	0	0	0	0	1	0
Sep 11	8	65	2	5	30	40	2	3	3
Sep 12	8	87	2	30	0	7	0	1	0
Sep 13	8	104	0	0	20	8	0	0	0
Sep 14	8	100	0	0	3	7	1	1	0
Sep 15	7	124	0	10	36	12	1	3	5
Sep 16	7	164	0	5	1	1	0	0	0
Sep 17	7	63	0	8	0	5	0	2	0
Sep 18	8	19	0	2	0	2	1	0	0

continued

Table 30. Daily counts of adult salmonids at Yehring Creek, Taku River, 1988 (continued).

Date	Water		Adult coho salmon						
	Temp. (°C)	Depth (cm)	Adip. Clip	Not Clipped	Counted Through	Sockeye	Pink	Chum	Dolly Varden
Sep 19	7	12	0	18	0	1	0	0	0
Sep 20	8	15	0	1	0	0	0	2	0
Sep 21	8	26	2	15	0	1	0	3	0
Sep 22	8	27	0	4	0	1	0	0	0
Sep 23	8	20	0	4	0	3	0	1	0
Sep 24	7	14	0	15	0	1	0	0	0
Sep 25	7	9	0	2	0	0	0	2	0
Sep 26	7	5	3	18	0	0	0	0	0
Sep 27	7	3	1	7	0	0	0	0	0
Sep 28	7	4	0	9	0	3	0	2	0
Sep 29	7	38	15	211	0	4	0	1	0
Sep 30	7	49	2	22	0	5	0	0	1
Oct 1	7	41	2	26	0	3	0	2	0
Oct 2	7	25	0	26	0	1	0	0	0
Oct 3	7	18	0	8	0	0	0	3	0
Oct 4	8	38	3	26	0	3	0	0	0
Oct 5	7	54	9	83	0	6	0	0	0
Oct 6	7	61	9	201	0	8	0	2	0
Oct 7	ND	92	9	123	0	1	0	0	1
Oct 8	7	88	3	48	0	2	0	0	0
Oct 9	7	81	3	101	0	2	0	1	1
Oct 10	7	64	1	17	0	1	0	0	0
Oct 11	7	49	0	3	0	0	0	0	0
Oct 12	7	49	0	11	0	1	0	2	0
Oct 13	7	41	1	10	0	1	0	1	0
Oct 14	7	34	1	7	0	0	0	0	0
Oct 15	6	27	1	4	0	0	0	0	0
Oct 16	6	23	0	2	0	0	0	0	0
Oct 17	6	21	0	2	0	0	0	1	0
Oct 18	6	17	1	12	0	2	0	0	0
Oct 19	5	31	0	4	0	0	0	0	0
Oct 20	6	28	0	4	0	1	0	1	1
Oct 21	6	31	1	3	0	1	0	1	0
Oct 22	4	26	0	3	0	0	0	1	0
Oct 23	weir out								
Total			88	1,245	90	336	72	68	20
Total coho salmon =				1,423					



Table 31. Mean length (mm mid-eye to fork), age, and sex composition of non-jack adult coho salmon sampled at Yehring Creek weir, 1988.

		Parent Year			Total
		1985	1984	1983	
		1.1	2.1	3.1	
Male	N	31	117	4	152
	Mean Length	634	648	598	644
	SD	78	73	124	76
	SE	14	7	62	6
	Percent Comp.	8.1	30.5	1.0	39.6
	SE (%)	4.2	3.7	5.0	3.4
Female	N	41	185	6	232
	Mean Length	669	679	682	678
	SD	27	40	11	38
	SE	4	3	4	3
	Percent Comp.	10.7	48.2	1.6	60.4
	SE (%)	4.2	3.1	4.7	2.7
Total	N	72	302	10	384
	Mean Length	654	668	648	665
	SD	58	57	84	58
	SE	7	3	27	3
	Percent Comp.	18.8	78.6	2.6	100.0
	SE (%)	4.0	2.0	4.5	-

Table 32. Estimated catch, SE, and harvest rate of Yehring Creek coho salmon returning in 1988.

Fishery	Catch (SE)	Harvest Rate
Troll	1,724 (310)	28%
Drift Gillnet (Dist. 111)	2,740 (383)	44%
Juneau Marine Sport	313 (166)	5%
Total harvest	4,777 (519)	77%
Escapement	1,423 ( - )	23%
Total Return	6,200 (519)	100%

Table 33. 1988 estimated harvest of Yehring Creek coho salmon by statistical week and period. There were 1,423 adults in the escapement of which 1,333 were examined for tags and the observed number of tagged fish was 88 for a tagged/untagged ratio of 0.066 (SE = 0.0017).

Week/ Area period		N Catch	n2 Sample	mc Tags	m1 Detected	m2 Decoded	a1 Ad Clip	a2 Heads	Est. Catch	SE
TROLL										
7/03 - 7/09	NW 28 3	7,125	1,506	1	17	17	18	18	72	71
7/17 - 7/23	NW 30 3	20,129	7,932	4	67	67	87	87	154	76
7/24 - 7/30	NW 31 3	13,716	5,796	1	44	44	49	49	36	35
8/07 - 8/13	NW 33 4	55,142	22,125	11	286	286	343	342	416	124
	NE 33 4	11,899	4,992	1	27	27	34	34	36	36
8/14 - 8/20	NW 34 4	38,600	20,089	5	258	258	303	297	148	65
8/28 - 9/03	NW 36 5	56,657	29,205	8	393	393	460	450	240	84
	NE 36 5	4,646	1,260	1	13	13	18	18	56	55
9/04 - 9/10	NW 37 6	37,302	9,742	3	98	98	120	120	174	100
9/11 - 9/17	NW 38 6	12,123	8,573	2	41	41	57	57	43	30
Tot/week		257,339	111,220	37	1,244	1,244	1,489	1,472	1,375	232
6/26 - 7/30	NW 3	53,459	18,337	6	149	149	181	171	280	113
7/31 - 8/20	NW 4	180,393	42,456	16	552	552	653	647	1,039	258
	NE 4	19,697	8,536	1	64	64	75	75	35	34
8/21 - 9/03	NW 5	72,081	30,283	8	427	427	495	483	296	103
	NE 5	6,998	1,858	1	18	14	19	19	73	73
8/28 - 9/24	NW 6	49,914	19,167	5	143	143	182	182	197	87
Tot/period		332,628	101,470	37	1,210	1,206	1,423	1,395	1,724	310

Continued

Table 33. 1988 estimated harvest of Yehring Creek coho salmon by statistical week and period. There were 1,423 adults in the escapement of which 1,333 were examined for tags and the observed number of tagged fish was 88 for a tagged/untagged ratio of 0.066, SE = 0.0017 (continued)

Week/ Area period	N Catch	n2 Sample	mc Tags	m1 Detected	m2 Decoded	a1 Ad Clip	a2 Heads	Est. Catch	SE
GILLNET									
8/07 - 8/13 111 33	1,371	732	1	7	7	9	9	28	28
8/14 - 8/20 111 34	4,001	869	6	8	8	8	8	418	169
8/21 - 8/27 111 35	5,936	3,564	6	18	18	24	24	151	61
8/28 - 9/03 111 36	13,038	6,400	26	89	89	103	103	802	155
9/04 - 9/10 111 37	14,365	3,215	12	66	66	75	75	812	232
115 37	17,600	4,847	3	28	28	36	35	170	97
9/11 - 9/17 111 38	2,504	391	1	5	5	6	6	97	97
115 38	19,317	4,088	3	21	21	24	24	215	123
9/18 - 9/24 111 39	299	99	1	2	2	2	2	46	45
	78,431	24,205	59	244	244	287	286	2,740	383
Juneau Marine Sport <sup>1</sup>									
7/31 - 8/06 32 16	3,369	1,672	1	13	13	13	13	31	30
8/21 - 8/27 35 17	4,524	729	3	11	11	11	11	282	164
			4	24	24	24	24	313	166
Total harvest (estimated by period)								4,777	519

<sup>1</sup> Estimates of sport catch are for bi-weekly strata, based on the sum of the tags recovered in each statweek.

Table 34. Cumulative coefficient of variation of Yehring Creek coded-wire tag recoveries in 1988.

Loc.	Wk	Fish.	SE/ Catch	% of Catch	Cum Catch	Cum Percent of Catch	Cum Var	Cum SE	Cum Coefficient. Variation
NW	28	TROL	99%	1.7%	72	1.7%	5,064	71	99%
NW	30	TROL	49%	3.7%	225	5.5%	10,820	104	46%
NW	31	TROL	99%	0.9%	261	6.4%	12,069	110	42%
	33	ALL	27%	11.8%	746	18.1%	29,672	172	23%
	34	ALL	30%	8.4%	1,092	26.5%	40,160	200	18%
111	35	GILL	40%	3.7%	1,243	30.2%	43,826	209	17%
	36	ALL	17%	26.4%	2,331	56.7%	76,499	277	12%
	37	ALL	23%	25.9%	3,396	82.6%	138,429	372	11%
NW	38	TROL	69%	1.0%	3,439	83.6%	139,304	373	11%
	38	ALL	50%	7.2%	3,734	90.8%	160,781	401	11%
111	39	GILL	99%	1.1%	3,780	91.9%	162,828	404	11%

The survival rate from smolt to adult in the ocean was 7.5% (SE  $\approx$  0.3%). The estimate was computed by dividing the 1988 estimated return by the 1987 estimated smolt abundance: 5,871 adults/77,761 smolt.

### Escapement Indices

Indices of coho salmon escapement trended downwards in 1988 relative to their recent averages (Table 35). However, precise measurement of this change was not possible. To determine if indices were accurate measures of spawner abundance, we compared indices from each management area to "hard counts" of spawners taken at weirs in those areas. We made the assumption that: 1) escapements counts at weirs provide a true representation of relative escapement and 2) that indices, if accurate, should follow the escapement trends observed at the weirs.

In the Sitka area, a strong relationship was present between escapement indices from streams and weir counts at Salmon Lake (Figure 5). We believe that the indices are correlated with weir counts because: 1) the index streams are small and fish are more visible; 2) the size of adult populations in the streams is small; 3) migratory timing is homogeneous; 4) and all fish arrive at the stream at the same time.

In the Juneau (Figure 6) and Ketchikan (Figure 7) areas, there is no correlation between escapement indices and weir counts. This may be due to several factors. In Juneau, there are no known differences in migratory timing or harvest rate that would explain the lack of correlation between weir counts and spawner indices. However, stream surveys were consistently done one to two weeks after the assumed peak of migration. Variation in the stream life of adult coho salmon may have caused the lack of correlation. The same applies to the Ketchikan area. In addition, data from Ketchikan is weak because of incomplete data.

A weighted mean index of escapement (Appendix Table 3) was computed for the region using the index data described above. The mean was estimated by stratifying the indices by stream size and weighing each stratum by the estimated number of those streams in the region. The weighted mean escapement index for 1986 - 1988 are:

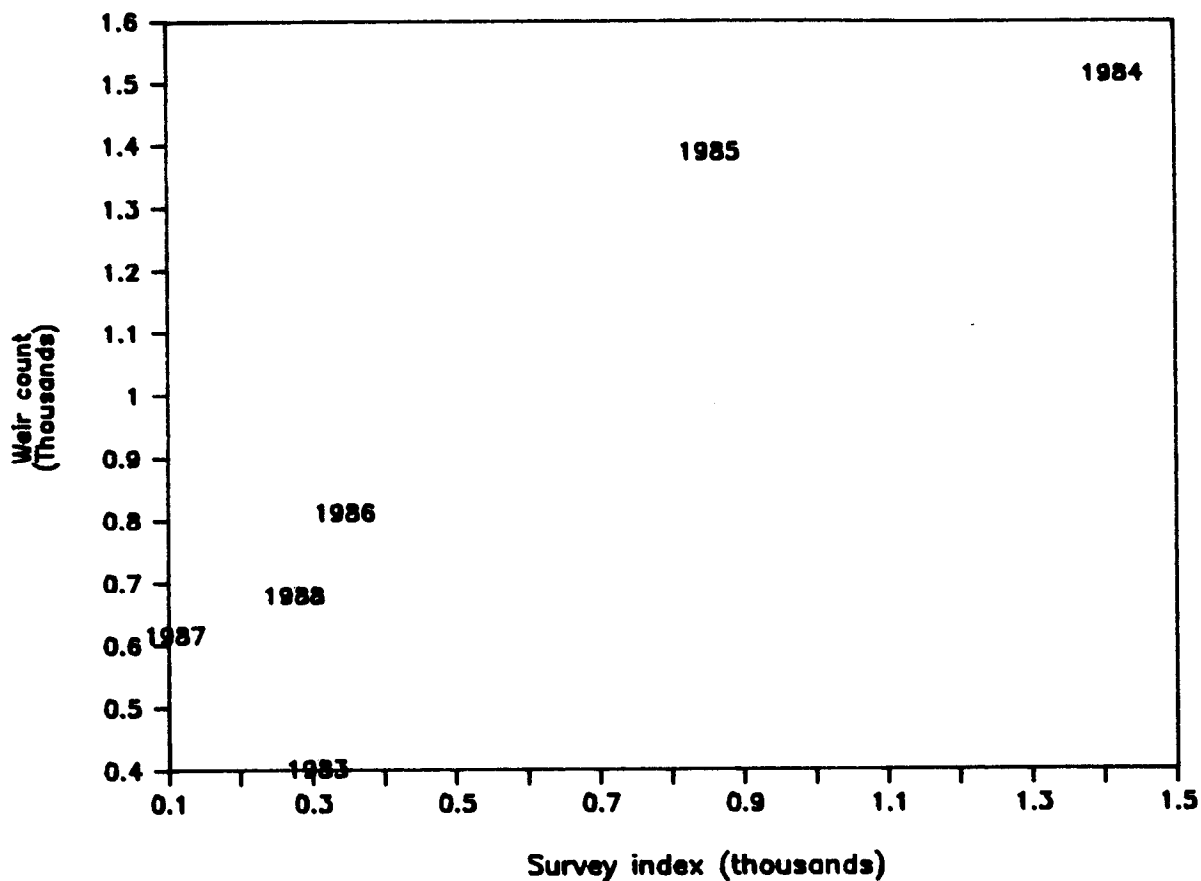
Year	Weighted mean	SE	Number of Streams
1986	391	129	64
1987	440	109	78
1988	622	259	58

### In-Season Forecast of Coho Salmon Run Strength

Prediction of run strength is a fundamental requirement for management of the coho salmon fisheries. Managers must know how many fish are returning to

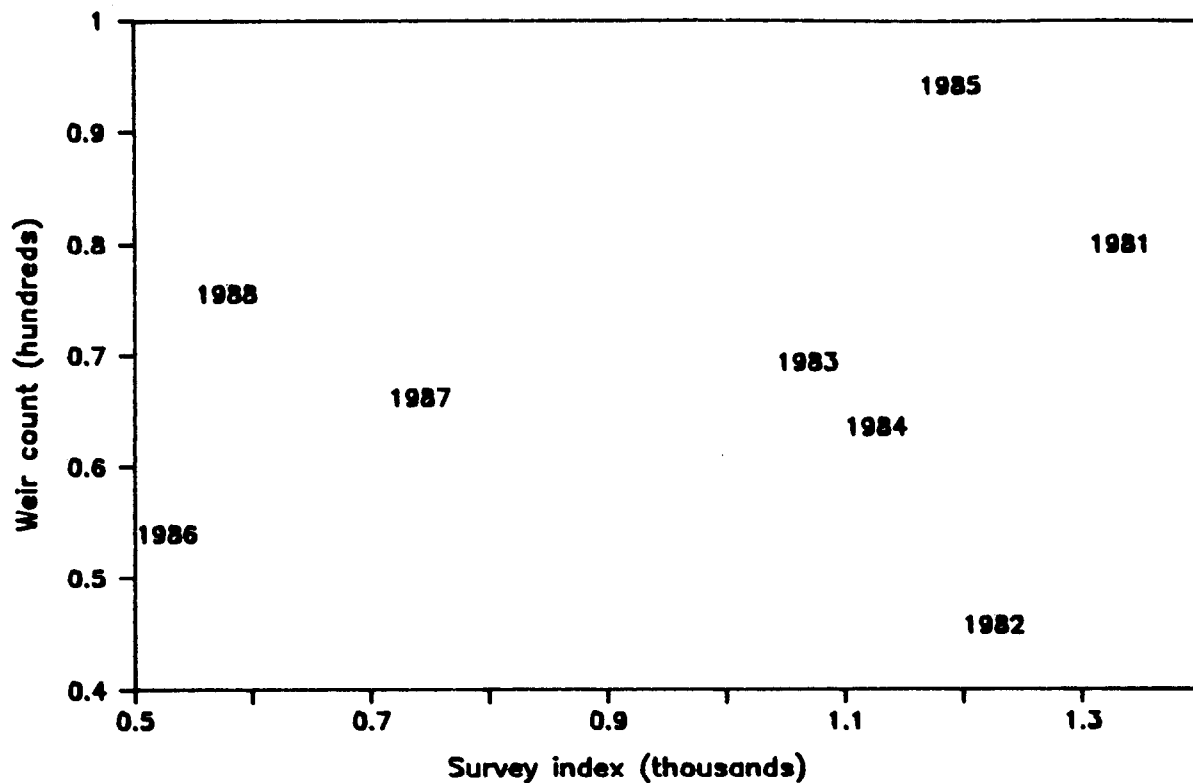
Table 35. Percent change of 1988 coho salmon escapement indices in southeast Alaska from historical averages.

Area	Period of Average	Index		Percent Change
		Ave.	1988	
Ketchikan				
Spawner index	1983 - 1987	1,912	698	- 63%
Hugh Smith Lake weir	1983 - 1987	1,323	513	- 61%
Sitka				
Spawner index	1981 - 1987	639	108	- 83%
Salmon Lake weir	1983 - 1987	946	680	- 28%
Ford Arm Lake	1982 - 1987	2,034	3,028	+ 48%
Juneau				
Spawner index	1981 - 1987	1,030	578	- 43%
Auke Creek weir	1981 - 1987	676	756	+ 12%
Lynn Canal				
Berners River index	1974 - 1987	4,117	3,260	- 21%
Haines area				
Chilkat/Chilkoot weirs	1981 - 1987	1,793	2,745	+ 53%
Yakutat area				
Situk River	1973 - 1987	5,674	11,000	+ 93%
Tsiu/Tsivat Rivers	1973 - 1987	24,840	16,000	- 35%

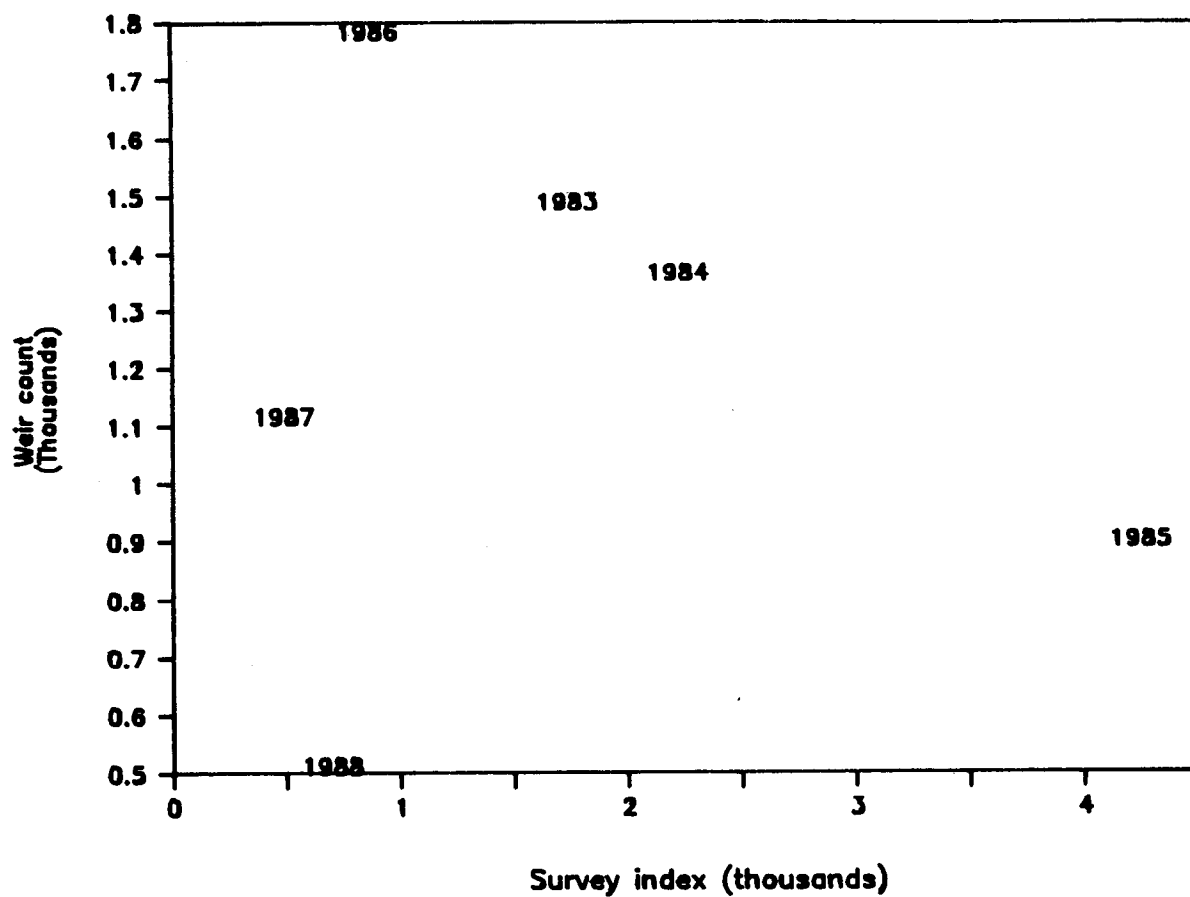


**Figure 5. Relationship between the annual sum of coho salmon spawner indices from Starrigavan Creek, Sinitain Creek, St. Johns Creek and Nakwasina River and counts of adult coho salmon from Salmon Lake weir, 1983 – 1988.**





**Figure 6.** Relationship of the annual sum of coho salmon spawner indices from Jordan Creek, Steep Creek, Montana Creek, and Switzer Creek to counts of adults at the Auke Lake weir, 1981 - 1988.



**Figure 7. Relationship of the annual sum of coho spawner indices from Indian River, Carrol River, and Eulachon River to counts of adults at Hugh Smith Lake weir, 1983 – 1988.**

optimize catch and achieve escapement and allocation goals. Since 1986, run strength has varied between northern Southeast Alaska and southern Southeast Alaska. In 1986 the northern portion was relatively weak, while the south was strong; in 1988 the north was strong and the south was weak. These alternating conditions has resulted in overharvest in the different subregions.

The Southern Southeast Regional Aquaculture Association (SSRAA) has developed a method to forecast the total return of their stocks. The method is a regression model of the early catch of their hatchery stock to the total return of their hatchery stock. This method is reproduced here using selected Neets Bay (Neets Bay hatchery) and Herring Cove (Whitman Lake hatchery) stocks with the cumulative weekly catch as the independent variable and the total return (catch + cost recovery + brood stock).

Table 36 presents the catch of SSRRA stocks in the troll fishery operating in the NW fishery quadrant. The catch can be used as a relative indicator of run strength: 1) if catches are high in week 26, a good run is likely to develop; 2) if catches are poor through week 29-30, a poor run will develop; 3) catches between those extremes suggest a moderate run. Estimation of run size is more difficult. Significant regressions were found between cumulative catch and total return of SSRRA stocks from week 26 through 30 (Table 37). However, this was due to the large number of zero catches in early weeks and "outliers" in 1985 and 1986 (Figure 8). By week 30, the regression is still "skewed" - from a cloud of points near the origin which are linear with the 1985 and 1986 catches. Elimination of the 1985 and 1986 data results in a less significant regression with a lower  $r^2$  value (Table 38).

Table 36. Cumulative catch of selected Neets Bay and Whitman Lake hatchery coho salmon in the troll fishery in the NW quadrant by statistical week and the estimated return, 1981 to 1988.

Year	Statistical Week					Estimated Return
	26	27	28	29	30	
1981	0	0	0	224	696	23,299
1982	46	58	551	2,183	4,260	37,253
1983	0	0	603	3,875	7,897	51,815
1984	198	278	1,423	5,960	11,441	118,146
1985	0	15,461	19,052	32,222	43,816	171,243
1986	1,273	16,723	38,477	69,352	89,335	441,298
1987	0	451	1,192	2,492	3,567	99,048
1988	0	0	27	27	44	10,916

Table 37. Linear regression statistics for selected Neets Bay and Whitman Lake coho salmon. Model is cumulative catch by statistical week vs total return, 1980 - 1988.

Regression Statistic	Statistical Week				
	Week 26	Week 27	Week 28	Week 29	Week 30
Intercept	63,080.60	52,649.00	45,251.57	38,088.12	31,290.68
X Coeff.	295.57	16.13	9.64	5.57	4.36
F Value	37.92	15.20	69.12	97.20	98.03
Prob > F	0.0008	0.0080	0.0002	0.0001	0.0001
r <sup>2</sup>	0.8634	0.7169	0.9201	0.9419	0.9423

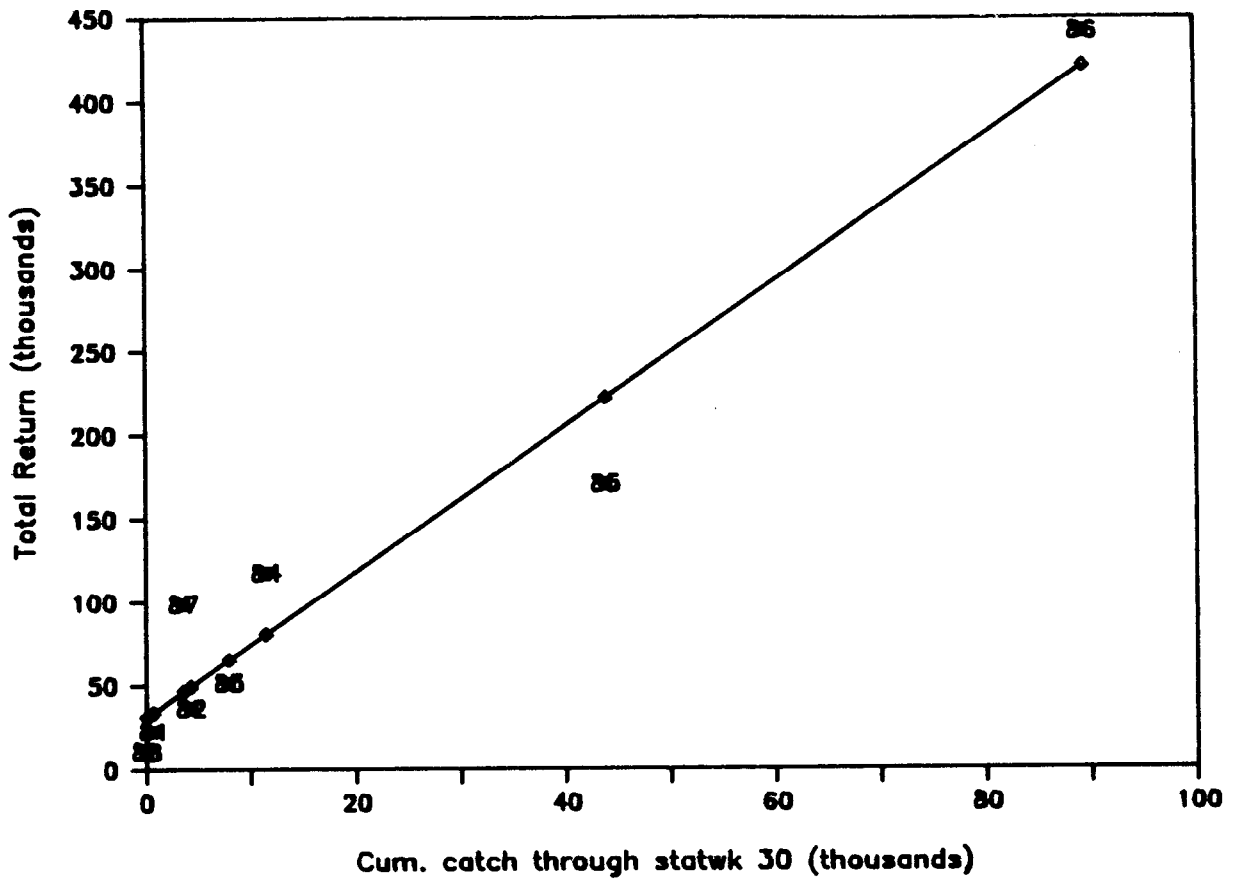


Figure 8. Relationship of the cumulative catch of selected Neets Bay and Whitman Lake coho salmon in the NW quadrant troll fishery to the estimated return of those stocks, 1981 - 1988.

Table 38. Linear regression statistics for selected Neets Bay and Whitman Lake coho salmon. Model is cumulative catch by statistical week vs total return, 1981 - 1988 excluding 1985 and 1986.

Regression Statistic	Statistical Week				
	Week 26	Week 27	Week 28	Week 29	Week 30
Intercept	42,161.23	31,345.22	11,352.77	17,677.64	22,118.69
X Coeff.	358.64	193.65	71.75	15.88	7.45
F Value	3.14	11.29	95.59	9.047	5.357
Prob > F	0.1511	0.0283	0.0006	0.0396	0.816
r <sup>2</sup>	0.4398	0.7385	0.9599	0.6934	0.5725

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Appendix Table 1. Catch of coho salmon in the District 111 and District 115 drift gillnet fisheries, troll fishery and total catch, 1960 -1988. Adopted from Larson (1989).

Year	Dist. 111	Dist. 115	Total Troll	Total Catch
1960	22,379	10,964	396,211	681,604
1961	15,743	19,210	399,932	833,609
1962	15,661	25,769	643,740	1,156,277
1963	10,855	36,498	693,050	1,265,328
1964	29,315	34,898	730,766	1,586,258
1965	32,667	40,969	695,887	1,543,807
1966	26,065	43,022	528,621	1,218,827
1967	40,391	68,063	443,677	864,250
1968	39,103	45,419	779,500	1,539,686
1969	10,802	35,320	388,459	597,240
1970	44,960	49,174	267,647	759,489
1971	41,830	49,496	391,279	914,106
1972	49,780	58,556	791,947	1,508,936
1973	35,453	26,153	540,125	835,837
1974	38,667	64,881	844,748	1,276,529
1975	1,185	57,543	214,170	427,357
1976	41,729	71,984	524,762	823,667
1977	54,917	91,426	506,887	1,035,543
1978	31,944	53,165	1,100,902	1,712,416
1979	16,194	27,015	918,845	1,284,635
1980	41,677	28,898	707,360	1,136,685
1981	26,711	44,650	862,177	1,406,414
1982	29,072	72,370	1,321,546	2,130,763
1983	21,455	69,510	1,279,518	1,989,112
1984	33,836	68,076	1,131,936	1,897,650
1985	55,251	98,347	1,603,110	2,580,598
1986	30,512	82,121	2,126,159	3,327,037
1987	35,173	53,635	1,041,140	1,527,047
1971-1980 ave.	30,539	44,687	595,644	1,095,337
1981-1987 ave.	33,144	69,816	1,337,941	2,122,660
Prelim. 1988	45,094	81,397	500,148	1,042,706

Appendix Table 2. Annual sport harvests of coho salmon in southeast Alaska by selected fisheries, 1977 - 1987. Adopted from Suchanek (1989).

Southeast Alaska excluding Yakutat							
Year	Juneau Marine	Ketchikan Marine	Sitka Marine	Other Marine	Total Freshwater	Yakutat	Total Southeast
1977	17,703	4,210	2,855	6,871	3,107	1,406	36,152
1978	22,312	7,177	2,188	10,319	3,331	3,181	48,508
1979	9,726	2,281	1,554	5,008	1,580	2,963	23,112
1980	12,252	6,604	1,876	4,845	4,916	2,315	32,808
1981	8,921	4,643	3,122	4,278	4,710	2,484	28,158
1982	22,542	10,804	3,741	8,407	5,133	2,809	53,436
1983	15,787	12,969	4,312	11,146	8,861	2,328	55,403
1984	13,509	19,918	2,389	9,206	8,112	6,675	59,812
1985	16,757	17,005	3,332	10,651	5,594	6,571	59,910
1986	11,150	20,688	3,962	11,141	4,951	6,430	58,322
1987	16,639	13,146	2,673	9,290	5,549	2,987	50,284
Average	15,209	10,859	2,909	8,287	5,077	3,650	45,991
Preliminary 1988 <sup>1</sup>	12,016	5,519	619				35,500

<sup>1</sup> 1988 estimate are based on onsite creel census which may vary from Mills (1988) postal surveys.

Appendix Table 3. Weighted mean coho salmon spawner index for southeast Alaska, 1988.

Strata (miles)	Streams in samp. ( $n_i$ )	Streams in Region ( $N_i$ )	Mean Index ( $X_i$ )	Weighted Mean	Variance	SE
< 5	15	1,525	245	129.52	2,273	-
5-20	23	701	1,046	254.45	44,391	-
> 20	13	468	388	63.02	408	-
Lakes	7	189	2675	175.33	20,169	-
Total	58	2,883		622.32	67,241	259